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THE PRACTICAL ENGINEER

Vol. VI. Philadelphia, October, 1902. No. 9.

Engines, Pumps and Machinery Repaired Quickly and Well

The old saying that a "stitch in time saves nine" applies to a steam engine with greater force than to most things, for when an engine is in need of repairs, she not only gets worse very rapidly, but she becomes a mighty extravagant servant and soon wastes more fuel than would pay the repair bill.

WE MAKE A.... SPECIALTY OF **Repairing Steam Engines and Pumps**

We Rebore Cylinders in Present Position from 3 inch to 110 inch in Diameter

H. B. UNDERWOOD & CO.

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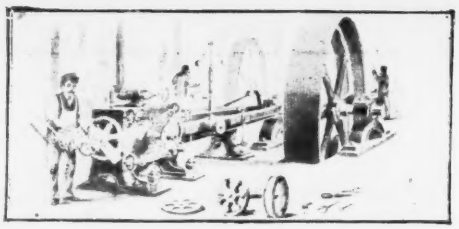
Dynamo Commutators Turned Off Without Removal

Builders of Dash Pots

Portable Planer For Facing Off All Sizes of Hammer Blocks In Present Position



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Steam Power Hammers

We Send Experienced Mechanics With Portable Tools To All Parts of the Country To Repair Engines and Pumps

Portable Milling Machine for Milling Off Valve Seats in Position.

Ice Machine Repairs a Specialty. Sole Agents for St. John Self-Adjusting Cylinder Packing.

Send for our book of useful hints for Engineers.

Crank-Shaft Journals of all sizes turned off without removal.

WALSH METAL FACE PACKING.

Patented October 7, 1890, June 6 and December 8, 1891.

A—Fibrous Packing. B—Metal.
C—Open space to avoid butting when cover is worn off.
D—Section of metal cut out at C.

Adapted to all kinds of Steam and Water Packing. Will not cut Rods, will not wear rods to shoulder, will not harden under compression. More durable than Fibrous Packing. Less friction, as it is Lubricant of itself. For Packing Engines, Steam Hammers, Cranes, Valves, Expansion Joints, Pumps, Elevators, Accumulators, Hot Water Plunger Pumps, etc. **Cotton, Linen and Square Flax Packing in Stock.**

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A—Soft Metal. BB—Rainbow Rubber. Composed of Soft Metal and Rainbow Rubber as shown in cut. Made different widths and thicknesses or man and hand hole Gaskets.

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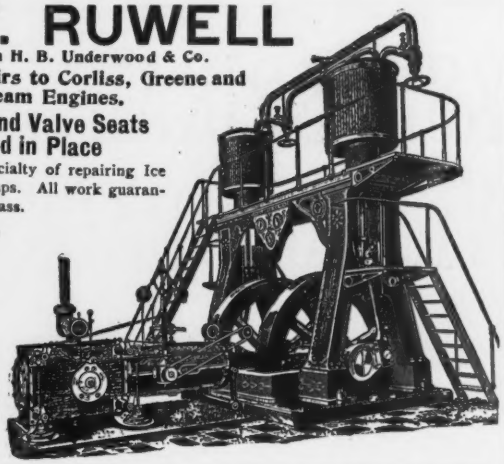

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Thos. P. Davidson

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Manufacturer of

GOODWIN CUT-OFF GOVERNORS,

407 COLUMBIA AVE., PHILA.

This Governor having been applied to a large number of steam engines with a degree of success that establishes its superiority over all other Governors now in use. It can be recommended to obtain for engines regularity of speed and economy of fuel. Its great value has been best demonstrated where it has replaced other governors on engines, which have been in use and where care has been taken to compare the quantity of fuel used before and after the cut-off was applied to their engine a saving of 20 per cent or more may be relied upon, or a corresponding increase in horse-power of engine. A large number are in use in various parts of the country and with excellent results, both as to economy and steadiness of power.

SHILLITTO'S Hand-Book of Corliss Steam Engines for a club of three subscribers to THE PRACTICAL ENGINEER, at 50 cents each.

James Gemmell Phones {Bell 42-69 D / Keystone 44-65 D}

CYLINDERS OF ENGINES AND PUMPS REBORED IN PLACE

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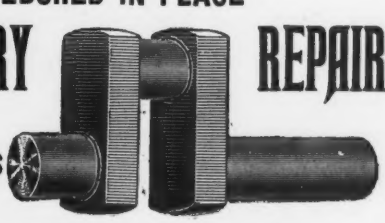

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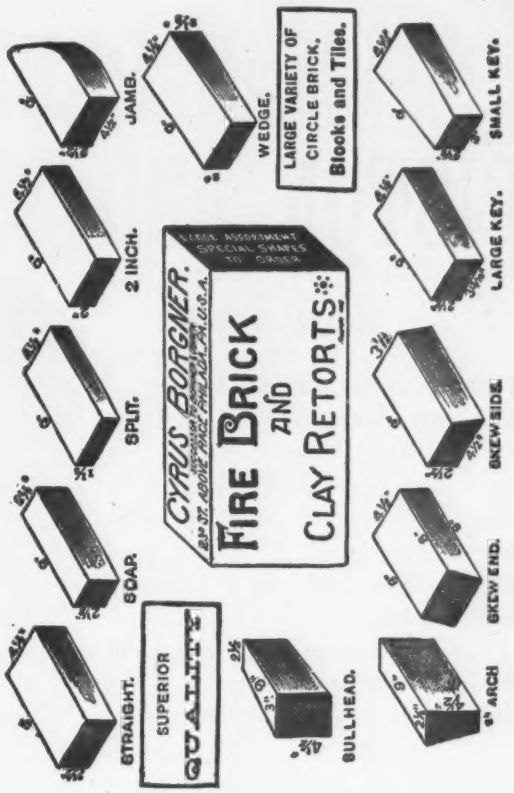

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GEORGE RICKARDS, MANAGER

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Cylinders and Valve Ports of engines and pumps of all makes and sizes rebored, and flat valve seats refaced without removing them from their present positions. All kinds of heavy machine work done at short notice. Pipe cut from ¼ in. to 6 in. diameter.

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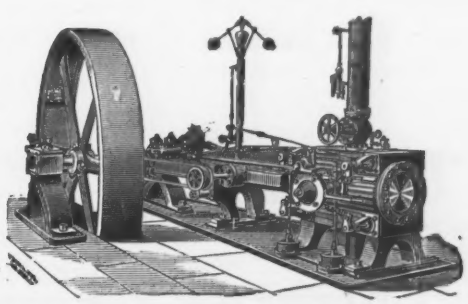

The Rickards Corliss Engine

is unequaled for efficiency and durability. You cannot afford to buy a new engine until you have seen it

THE PEERLESS SPIRAL PISTON AND VALVE ROD PACKING

ESCANABA, MICH.,
Sept., 16, 1901.
THE PEERLESS RUBBER MFG. CO.,
NEW YORK.

SIRS:—I wish to give you my testimonial in regard to Peerless Piston and Valve Rod Packing. Have used it for the past twelve years and put it to some severe tests.

While in charge of the Escanaba & Gladstone Transportation Co.'s Steamer "Lotus," which has a compound engine and steam at 140 lbs., we ran 22,000 miles on a single packing.

Congratulating you on the success of the same, and assuring you that I shall always recommend it when I possibly can, I remain,

Yours truly,
ALFRED LARSON,
Chief Engineer, Escanaba Water Works

LOOK FOR THIS LABEL
ON EVERY BOX

Twelve to Eighteen Months in High Speed Engines Without Repacking

CAUTION:—A Facsimile of this Label is glued around each and every coil of the genuine Peerless Piston and Valve Rod Packing

MADE IN THREE DIFFERENT SHAPES:—STRAIGHT, SPIRAL AND SQUARE SPIRAL.
IN SIZES FROM ¼ INCH TO 2 INCHES.

Sole Manufacturers of the

Celebrated "Rainbow Packing," "Peerless Piston and Valve Rod Packing," "Eclipse Sectional Rainbow Gasket," "Hercules Combination," "Honest John," "Zero," "Success," "Arctic" and "Germane Packings."

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The Practical Engineer

THE
OFFICIAL ORGAN
OF THE
AMERICAN ORDER
OF STEAM ENGINEERS

Devoted to the Interests of Stationary Engineers.

VOL. VI. PHILADELPHIA, OCTOBER, 1902 No. 9

Steam or Gas Engine

The question of gas engine supremacy over that of steam in the future has, in the past, and will continue to cause the steam engineer some apprehension lest he lose a profession. Up to the present time the steam engine has maintained in almost every case the upperhand, but that it shall continue to do so is by no means certain. It must be remembered that the steam engine has practically reached the limit in its evolution, while the gas engine has as yet been given but little study by our brighter mechanics. Hence, it is safe to say that the gas engine has much to be improved upon as yet before it can supplant its formidable rival—steam. But in the fact that there is room for improvement lies its chance of success. One of America's most prominent engineers, and a man of unquestionable ability, Prof. R. H. Thurston, was quoted before the American Institute of Electrical Engineers as saying:

"The best work, to date, is practically the same for both gas and steam engines. Each has delivered the net horse-power with a consumption equivalent to about one pound of good coal. The consumption of such fuel for efficiency and unity would be about one-fifth of a pound per horse-power, and these engines have thus both attained an efficiency between the coal pile and the point of delivery—of about 20 per cent.

"The steam engine has attained so nearly its limit that further progress under commercial conditions would seem to be likely to be hereafter very slow and to be dependent mainly upon the possibility of increasing the thermodynamic efficiency by extending the thermodynamic range of working temperatures. In the steam engine, this range may be increased either by still further increasing the working pressure at the boiler, or by superheating the steam, or by both experiments combined. Higher pressures are coming to be available, with progress in the construction of high pressure, presumably water-tube boilers, and we have, in Sibley College work, employed over a thousand pounds without special difficulty, and, I have no doubt that we can quite as well, as did Perkins two generations ago, use pressures of 2,000 pounds and probably more. We are now beginning to find practical methods of construction and use of super-heaters for ordinary pressures, and I have little doubt that we will be able to superheat steam of those higher pressures in course of time. These improvements should permit the increase of efficiencies by something like 50 per cent. and bring the consumption of fuel down to three-fourths of a pound of good fuel per horse-power hour, and perhaps within the next generation, if not within 10 years.

"I am not prepared to say what should be hoped for with the gas engine; but the indications at the moment would seem to be that, as we have a very much larger opportunity to reduce wastes that now characterize the gas engine than to extinguish those affecting the steam engine, more should be expected from the coming years with the former than with the latter. The gas engine has only now come to be a formidable rival of the steam engine, and is gaining upon it rapidly. The deduction seems fair, therefore, that the next few years should see the gas engine so much improved as to permit it, for many places and purposes, to become a successful rival. In some directions, as at sea, in the locomotive and perhaps in some other departments, it is possible that steam may continue to hold its place unchallenged, but this is by no means certain.

"It is unquestionably the fact that to-day the gas engine is steadily overhauling the steam engine and as steadily displacing it in many directions. I think it extremely possible that it may ultimately displace it very largely, but I think that the steam engine is likely to hold a place

among economically available prime movers for a long time to come, and no one can say what may be anticipated to follow its further improvement by effectively combining a maximum range of pressure and a maximum range of coincident temperature, the one giving maximum mechanical efficiency and the other maximum thermodynamic, the combination yielding what is the main object of selection in practically all cases—production of power with minimum costs on all accounts, production of power with least reduction of dividend-paying capacity."

That our leading manufacturers are awakening to the possibilities of the gas engine is daily becoming more apparent, hence we may look for rapid advancement in this line, for once the demand appears for an article, American mechanical genius knows no bonds.

✣ ✣ ✣

Boilers—Water Tube vs. Fire Tube

The relative value of the water tube boiler over that of the fire tube variety has been the subject of many discourses and much writing, and, strange to say nine out of every ten authorities on the subject presumes that the water tube boiler is not only the most economical but that it also contains the least chance of danger to life and limb—one authority going so far as to say that where loss of life occurs through the explosion of a fire tube boiler, the owners should be prosecuted for manslaughter; he taking the ground that all such boilers should be substituted at once with the so-called safety water tube boiler. Going further than this the same writer quotes numerous instances of fatalities and loss in property through neglect of such action, and in a general summary of the merits of the two types of boilers, he shows many points of value in the water tube boiler which are undoubtedly correct. But there he ceases; he does not give (correctly) a fair comparison. For instance, in summing up the two, he neglects conditions; if we take any two well constructed boilers, one of the water tube, and the other of the modern horizontal fire tube type, and place them side by side, giving each the proper attention, which all boilers should have, and use the two year in and year out, say for ten years, and all the time keep a careful record of results, in the matter of water evaporation, coal used, time consumed in cleaning, periods of shut-downs, the new tubes required, new gaskets, etc. We may find at the end of that period that the water tube boiler has been the most expensive to maintain.

It is not our intention to disparage the water tube boiler, for where a quick steamer is essential, the water tube will fill the bill better than the fire tube. But, we must take into consideration the vast number of fire tube boilers in use for various purposes, where incompent persons have charge of them—for instance, saw mills in isolated districts, threshing machine boilers, laundries and other like places where the average attendant scarcely knows why he puts water in the boiler. Now place the water tube style of boilers in the same place under the same conditions and you may find equally as high a percentage of loss in both property and life—for while a water tube boiler seldom causes serious loss of property, it is certainly prolific in fatalities or injuries to the attendants. A tube usually bursts just as the fireman opens the fire door—the in-rush of cold air causing a sudden contraction of the metal—with the result of having the fiery coals blown into his face. There is scarcely a water tube boiler that doesn't have such ruptures from time to time with more or less loss of life and limb attached to them. Hence we must not take the ideal condition as an example in summing up the merits of a boiler, but rather let us determine the work done by each under all conditions, and then make a decision as to merit.

✣ ✣ ✣

Ways and Means of Smoke Prevention

Various ways of abating the soft coal smoke nuisance were discussed by prominent members of the Franklin Institute at that place on the evening of September 17th. This subject has been more or less agitated ever since the inauguration of the present coal strike, which has made it necessary to use soft coal.

Among those present giving their opinion on the matter were such authorities as William Trautwine, Barnet Le Van, William Lockwood and John M. Hartman. Mr. Hartman is chairman of the Sub-Committee on "Smoke," of City Councils' Committee on "Boiler Inspection," of which we commented in our September number.

"Can the smoke nuisance be abolished?" asked Mr. Hartman. "No. Can it be abated? Yes; to the extent of about 80 per cent. To a certain extent the bituminous soft coal nuisance has come to stay, and it is the duty of the city to establish laws regulating its use, as in many other cities of the country. To a want of extra coking surface for boilers and to bad firing, with poor draught, the present nuisance in Philadelphia may be ascribed. The first part in the burning of soft coal is to drive off the volatile matter, called hydro-carbon, or gas. Burn it quickly, convert it into heat at once and change the remaining part of the coal into coke.

"The question is often asked: 'Why do some locomotives give forth great volumes of smoke and others none at all?' The answer is that some are fired with muscle and some with brains. With soft coal, attention is required every five minutes, if the coal is to be economically used and without smoke."

Barnet Le Van followed Mr. Hartman with a brief discussion on the same subject.

"Without any mechanical devices for consuming the smoke from soft coal,' he said, "the smoke can be reduced 80 per cent. by careful firing, and the remainder would not be likely to cause a public nuisance." Mr. Le Van said the simple explanation was more labor on the part of the fireman or stoker. First, a level bed of eight or ten inches in depth of incandescent fuel is secured, and this is maintained throughout the successive firings. At short intervals green coal is supplied to the front of the furnace, and

as the hydro-carbons are driven off, they are consumed in passing over the incandescent beds. Ordinarily this required a manipulation about every twenty minutes.

Many other solutions of the smoke nuisance were offered in the course of the session, and, although many differences of opinion were expressed, there was perfect unanimity among all the members as to the necessity for an adequate municipal law on the subject.

* * *

The Power Plant at the U. S. Post Office and Federal Court Building, Philadelphia

The accompanying illustrations are from photographs of the above plant, which is located about centrally in the basement of what is usually termed the "Philadelphia Post Office" at Market, Ninth and Chestnut Streets.

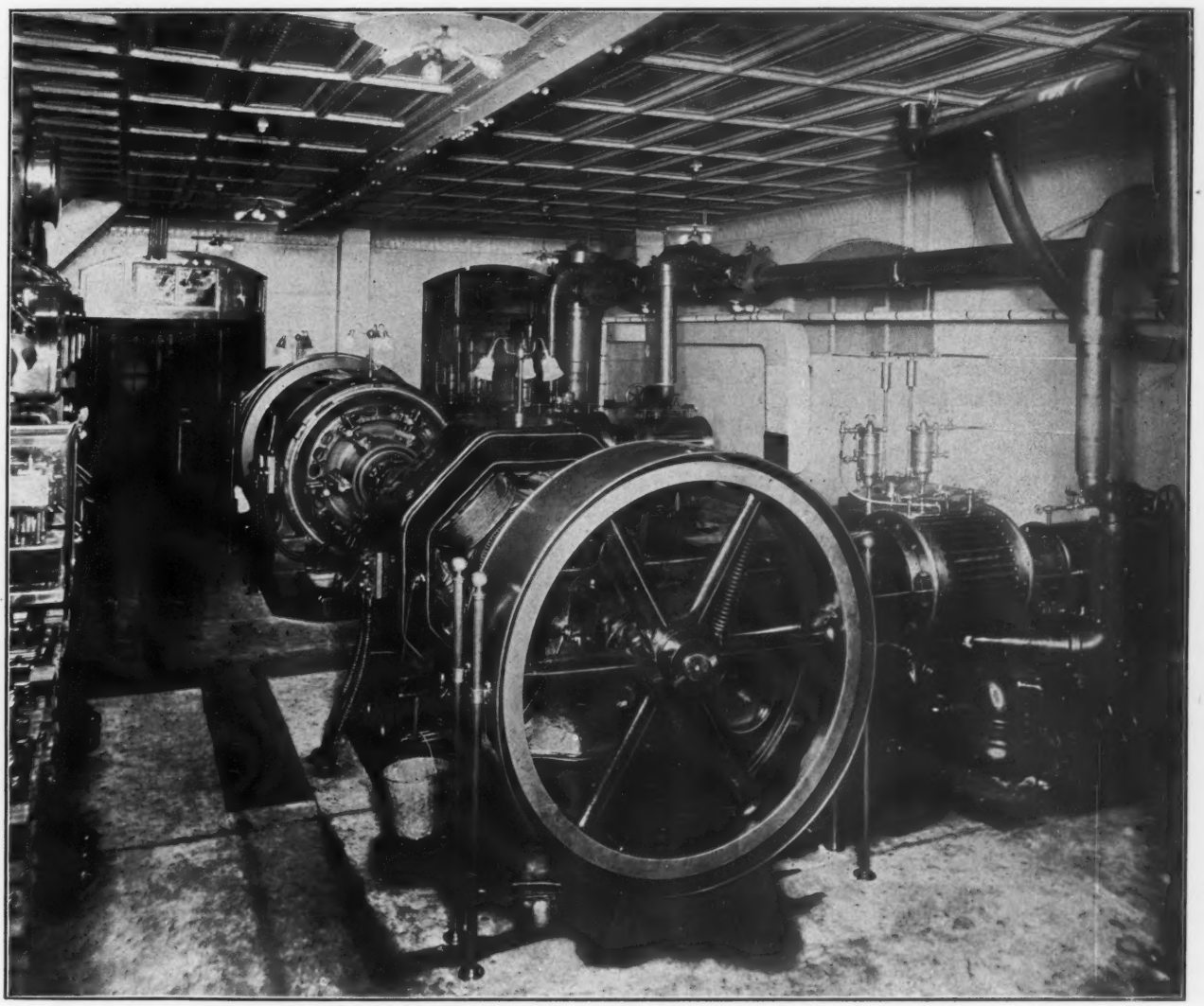
The steam plant consists of eight return tubular boilers, 48 inches diameter by 18 feet long, arranged in two batteries of four boilers each and located, one at each end and to the rear of the engine room. The boilers are all equipped with Hawley Down Draft furnaces in which bituminous fuel is used.

Two Worthington duplex pumps, 7½ and 4½x10, are used for feeding the boilers. The pressure carried is 110 lbs.

An eight-inch steam line runs through and around the engine room in a loop, connecting with all the boilers, making it possible for repairs to be made on any boiler or portion of the steam line without interfering with the operation of the plant.

Two Cochrane separators are located in the steam line, one at each end of the engine room. The drip from these is trapped, as are also the drips from high pressure cylinders of engines, into the receiving tank of the heating system, from which it is delivered into the feed water line by either of two duplicate small pumps controlled automatically by a Kieley pump governor.

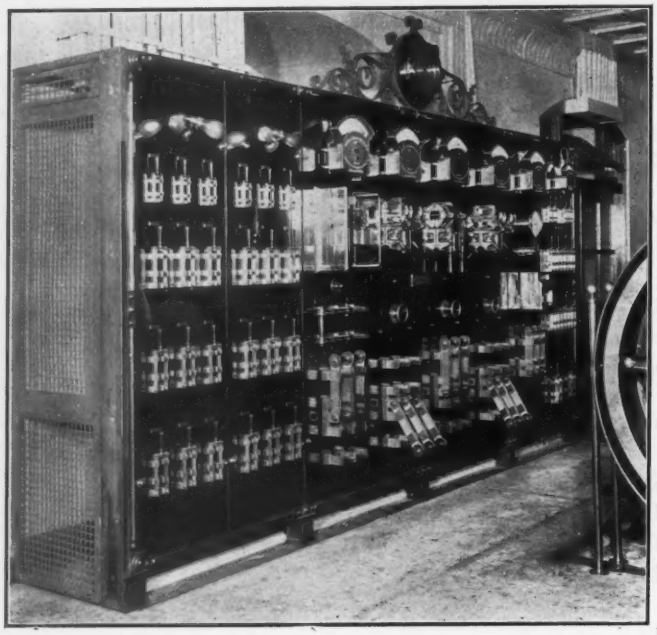
The blow-off from the boilers is connected to a large tank in which temperature of the water is reduced to 100° before it is discharged into the sewer. In the lower part of this tank is a coil of twenty feet of three-inch brass pipe through which the feed water passes on its way to the boiler feed pumps. In addition to this, the tank is fitted with a Powers' thermostatic regulator operating a diaphragm valve and cold water injector valve.



ENGINE AND DYNAMO ROOM OF PHILADELPHIA POST OFFICE AND FEDERAL COURT BUILDING.

The water is drawn from the tank through the diaphragm valve and discharged into the sewer by a duplicate set of 6″x4″x6 McGowan pumps, automatically controlled by a Kieley governor.

When the temperature of the water in the tank rises above 100°, the thermostat closes the diaphragm valve and opens the cold water injection valve until the temperature falls below 100° when the operation is reversed.



SWITCH-BOARD SHOWING ILLUMINATED AMMETERS.

The low pressure drips are connected to two Kieley low pressure traps discharging into a similar but smaller tank, the temperature in which is controlled in the same manner and whose contents are removed by the above mentioned pumps.

The hot water, for use in the building, is heated by means of the vent from this tank.

In the engine room the two tandem-compound Ball engines, with cylinders ten and eighteen inches diameter by twelve inches stroke, each direct connected to a 75 K. W. Eddy dynamo. Between these two is a Tandem compound Ball engine, with cylinders fourteen and twenty-two inches diameter by sixteen inches stroke, direct connected to a 125 K. W. Eddy dynamo, all of which were installed by the D'Olier Engineering Co.

The engines are connected to the eight-inch steam line running through engine room by "long turn pipe bends" in place of elbows or fittings.

The exhaust from all three engines is connected to a ten-inch exhaust main, which runs through a duct in the floor, and, after passing through a grease extractor and a feed water heater, passes to the atmosphere or to the heating system.

The ventilation of the engine room, as of other portions of the building, is effected by means of two large motor driven blowers—a number of outlets being distributed throughout the engine room.

A track suspended from the ceiling carries a two-ton traveling chain hoist.

The following extracts from the specifications, the requirements of which have been satisfactorily met, will show the performance of duty:

Engines—"Extreme variation from full load to no load, not to exceed one per cent."

Governor, to be "sufficiently sensitive to work immediately without racing."

"The complete average steam consumption, with 100 lbs. initial pressure, and with from one-half to full load, not to exceed twenty-three and one-half pounds of dry steam per I. H. P. per hour. Exhaust from engine to be condensed and weighed."

Dynamo—Output, 125 K. W. volts; at no load, 120; at full load, 124; amperes at full load, 1000.

"Commercial efficiency of machine, when hot, to be not less than: Full load, 91; three-quarter load, 91; one-half load, 86; one-quarter load, 80."

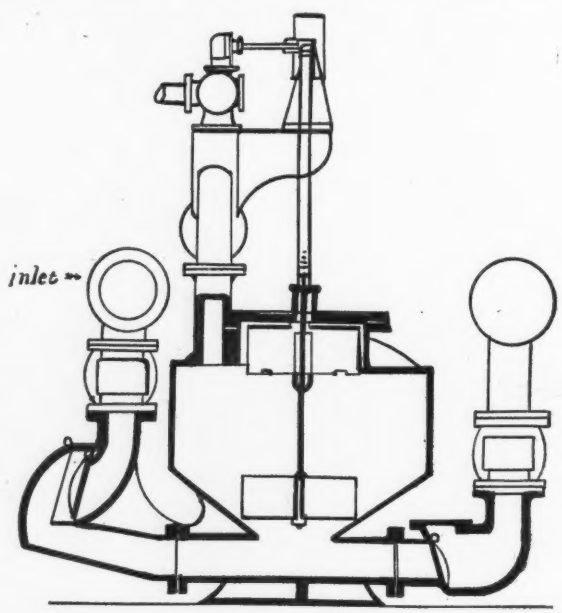
Heating, "after a period of twelve hours continuous run, under full load, not to exceed 75° F. above the temperature of surrounding atmosphere; and to be capable of carrying a 25 per cent. overload for one-half hour without injurious heating."

"Temperatures to be measured by thermometer shielded by cotton waste or by electrical resistance methods."

"Capable of being run not less than two hours on open circuit, with excited fields without generation of localized heat."

Armature to be of "toothed core construction, bar wound, in mica insulation; bars secured in place without the use of binding wire on body of armature." The specifications were furnished by Mr. J. E. Woodwell, Inspector of electric light plants for the Treasury Dept.

The switch-board is located on the west wall of the engine room and is fitted with illuminated dial volt and ammeters, Bristol recording meters and Thompson watt-meter, together with the necessary circuit breakers and switches for coupling the machines to the bus-bars and distributing current to the various portions of the building. This board was designed and built by the D'Olier Engineering Co., Philadelphia.



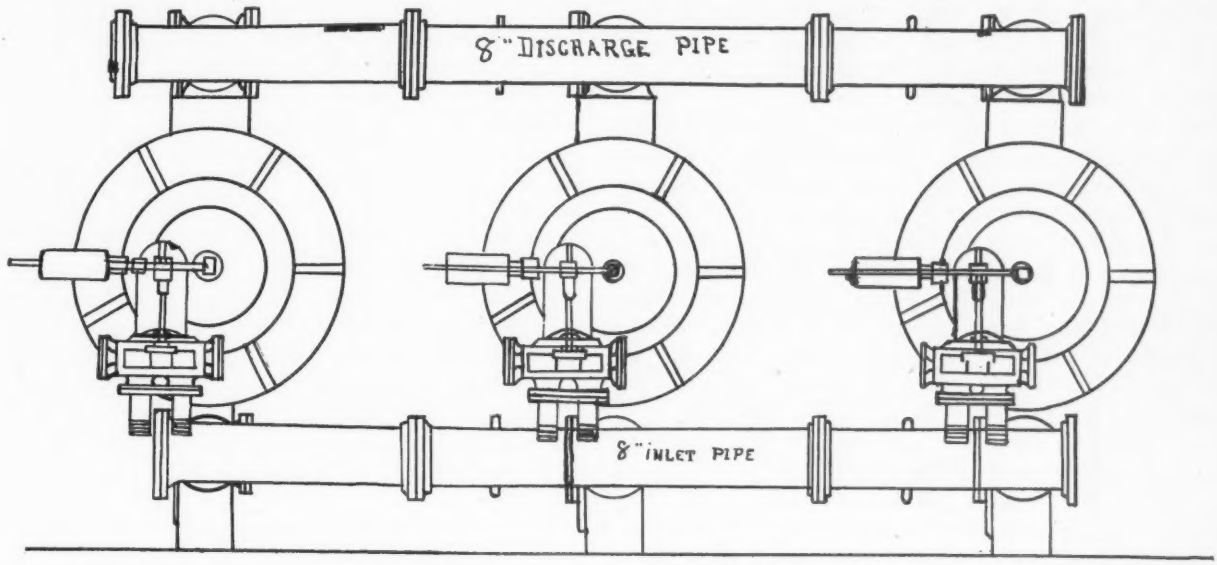
The building is heated by exhaust steam by means of the Warren-Webster heating system, the returns from which are fed to the boilers from the receiving tank by the small pumps mentioned above.

A feature of considerable interest, in this plant, is the method of disposing of sewerage—the lower portion of the building being below the sewer level.

This is accomplished by means of three ejectors, built by the Shone Sewerage Ejector Co., with a capacity of two hundred gallons per minute.

The accompanying sketches show the three ejectors and a sectional view of one of them. The operation is as follows:

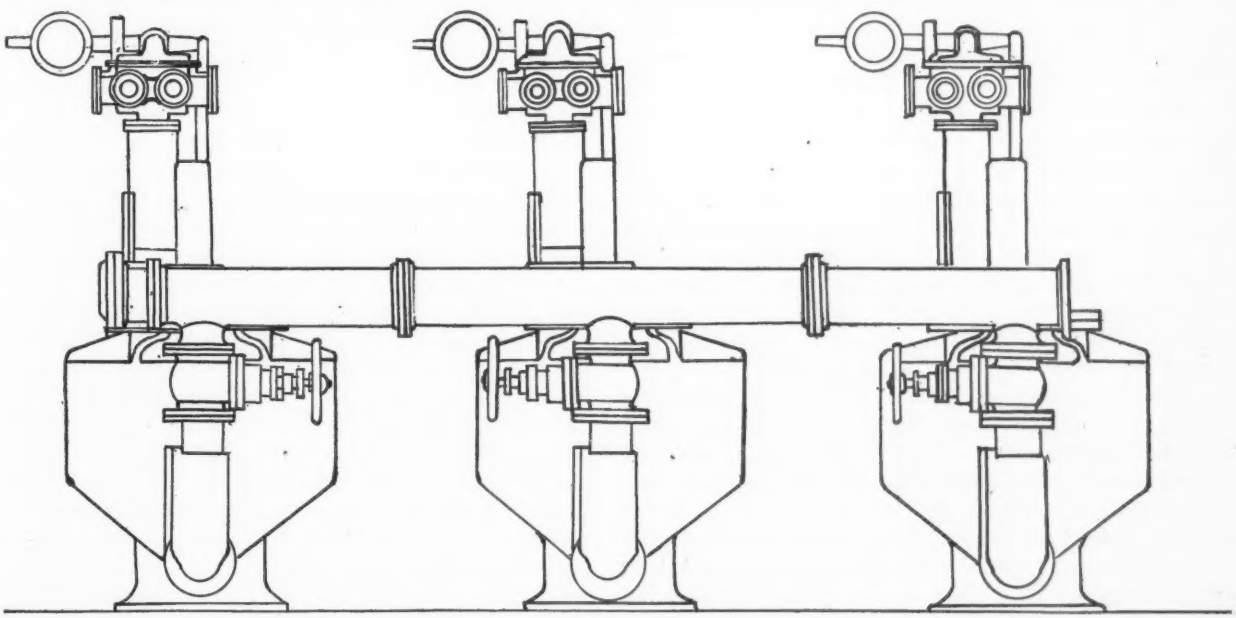
The sewage flows by gravity into the large cylindrical chamber raising a float, contained therein, which when it attains a height proportional to the capacity of the ejector, operates a valve, admitting compressed air; this acting upon a piston forces the contents out of the ejector into the sewer, the exhaust from the air cylinder being carried to the roof by a vent pipe. The entire system being enclosed, there is no possibility of any odors escaping into the building.



The compressors deliver air at 80 lbs. pressure to two storage tanks, from which it is used at 15 lbs. pressure for the ejectors, 15 lbs. for operating elevator doors, 20 lbs. for filter system and 65 lbs. for house service water tanks; the reduction of pressure to suit the various requirements being accomplished by means of Watson & McDaniel air regulators.

The water used in the building is obtained from the city mains, passing first into a large surge tank in which an air pressure, sufficient to nearly balance the water pressure, is maintained, and thence to two Loomis-Manning filters, with a capacity of 60 gallons per minute. The filters are by-passed in all directions, permitting the use of either one or both.

A duplicate set of McGowan triple power pumps transfers the water from the filters to the storage tanks, in which an air pressure of 65 lbs. is maintained for forcing the water to all parts of the building. The pumps are each driven by a 2 H. P. Crocker-Wheeler Motor and are automatically controlled by Cutler-Hammer Motor starters.



The compressed air for operating these ejectors is furnished by a duplicate set of Clayton air compressors belted from 13 H. P. Crocker-Wheeler multipolar motars controlled by Cutler-Hammer Automatic Motor starters.

Mr. J. H. O'Brien is Chief Engineer in charge of the plant.

The Ocean Trip of the Submarine Boat Fulton and its Results

The recent trip of the Submarine boat Fulton from New York to Washington on the outside under its own motive power marks the longest journey ever made by such a craft on this side of the Atlantic, the distance traveled being over one hundred miles.

The only similar performance by boats of like calibre on the other side being a trip, about one year ago, of a new boat of the submarine type—the Narval—owned by the French Navy; this boat made a trip of 260 miles at sea, and remained submerged for several hours as a test.

It was the intention to have the Fulton surpass the Narval's feat, and no doubt would have succeeded but for the rupture of a pipe which prevented a continuance of the trip until requisite repairs were made. The rupture was due to the accumulation of Sulphuric acid fumes around the storage batteries. However, no damage was done to either the boat or machinery of any material account; besides the accident revealed one thing of importance, and that was that even a submarine boat can withstand a severe injury in its engine-room and still remain afloat.

The Fulton is not strictly a United States war craft. She is what might be called a "hurry boat." She was built primarily to exhibit the possibilities of submarine warfare to the authorities in this country, and in time, perhaps, to be taken abroad for exhibition in other countries. The Fulton, however, is a duplicate of the six improved Holland boats which the government is now finishing at a cost of $170,000 each. After having ordered these new boats, Secretary Long recommended, in 1901, that no more be contracted for until it was learned how those already provided for would work. To answer all questions in this respect, and also to provide a boat upon which further experiments could be made, the Fulton was built. The attempted trip to Washington was the second of a series of severe practical tests as to the usefulness of this type of vessel. The first was on November 5, 1901, when the Fulton remained under water in Peconic Bay for fifteen hours without causing the crew inconvenience, and while a severe storm, dangerous to shipping, was raging overhead. Those on the Fulton did not know that a gale of sixty miles an hour was blowing. The accident at the Delaware Breakwater is not the first that has happened to the Fulton. Through some carelessness the valves were left open one night at her dock, and she sank, but that could have happened to any other vessel. Indeed it did happen to the battleship Texas, at the Brooklyn Navy Yard, before the Spanish War, but no serious damage was done in either case.

It has been established pretty thoroughly that there is little difficulty in solving the problem of submarine navigation. Nor is such navigation dangerous, necessarily. For more than 200 years experiments have been made with this kind of navigation, and there has been a belief that it has cost hundreds of lives. However, John P. Holland, the inventor of the submarine boat in use by the United States, has declared with vehemence that there is trace of only one life having been lost in this long series of experiments. In this he is sustained by Admiral Hichborn, the former Chief Constructor of the Navy who says that a man named Day, late in the seventeenth Century "has the unique distinction of being the only victim of the dangers of submarine navigation." Thirty-two other lives have been lost at various times on some of the crude craft used in experiments, but it was always when the boat concerned was on the surface and not operating under water that these lives were lost.

The Fulton and her sister boats, five of which are now being built by Great Britain, in England, are each 63 feet 4 inches long and have a diameter at their largest part of 11 feet 9 inches. For running on the surface a gasoline engine is used. This engine in each of the boats, develops 160 horse-power. This is calculated to produce a speed of from 7 to 10 knots an hour. For running under water electricity from storage batteries are used. A charging will last six hours, developing about 70 horse-power. The boats have a displacement when submerged of 120 tons, and may be sunk as deep as 100 feet.

On the American boats of the Holland type there is a dynamo, by which the battery-cells, may be recharged, but this must be done on the surface, when the gasoline engine may be run. The French boats have to be recharged at some central station.

In addition to the storage batteries, the boats of this class carry tanks of compressed air, for blowing out the water ballast, so as to provide a quick rise to the surface if necessary, for furnishing fresh air to the crew during period of submergence, and for discharging the torpedoes used in attack. The compressed air is stored in tanks at a pressure of 2,000 pounds to the square inch.

The armament of these vesesls consists of five Whitehead torpedoes each. These torpedoes are 11 feet 8 inches long, and carry sufficient explosive powder to destroy the largest vessel ever built. A modern torpedo anyway, is simply a submarine boat of itself, and the success in solving the problems of flotation, dirgibility and speed in torpedoes has the most direct bearing upon the matter of submarine navigation.

Each of these submarine boats has two rudders that run out behind it, like the feet of a duck while swimming. These rudders, when bent down or up, sink or raise the boat. The buoyancy of the boat, when filled with water is easily overcome, but nevertheless the boat will always come to the top when not in motion, and can only be kept down by the rudders when under way. The problem, therefore, is how to stop the boat from coming to the top.

One of these Holland boats can dive out of sight, when under motion, in from two to three seconds, and when in motion, in about fifteen seconds. Herein it has a great superiority over the French boats, in that it can dive. The French boats being made to settle gradually, and it requires from fifteen to twenty minutes to put them under water. The Holland boat can provide men with rough quarters, much better than sleeping on the ground, for several days, and then it would be easy to provide a relay crew. It requires only about six men to operate the boat. The captain stands in the conning-tower, steering the boat with a wheel, as ordinary boats are steered, and giving directions. The next man in importance is the man who regulates the depth of the diving, and who manages that end of the work. Then there is the engineer and his assistants.

France has something like thirty-four of these boats, many of them crude, and Great Britain had to do something. She ordered five of the Holland boats. The first of the five had its trial within a month, and was a success. France, in the year 1901, spent $1,462,000 on boats of this kind, developing the Narval and seven of her class, besides the Morse and Gustave Zede. If these boats do the work that they are intended to do

—and the Fulton started for Washington to try to prove that they can do it—experts say that every naval power must have them, and that as great a revolution is coming in naval ships, as when they were changed from sail power to steam power. Admiral Dewey says that one or two of these boats would wear out the crews of any blockading fleet. It is the only kind of vessel against which their can be no defense, for submarine boats cannot be made to fight against submarine boats.

Progressive American.

+ + +

The How and Why of the Corliss Engine

By T. DUNCAN JUST

There are many engineers, under whose control Corliss engines are placed who have but little or no knowledge of the intricacies or method of operation of the Corliss valve gear, and who are at a loss what to do in case the valve should need adjustment.

In order that every one so placed may be in a position to make required changes with a full understanding, of both the object in view and the work to be done, we will endeavor to portray the Corliss engine in as graphic and simple a form as possible. In the first place it is well to know that there are two general classes of the Corliss engine. Many manufacturers of this type of engine have added improvements and alterations of more or less merit, but the general character of the valve gear is seldom materially changed; hence, a full understanding of one will insure the ability to properly care for any design encountered by the engineer.

To the first class belong the crab claw gear, originally used by George H. Corliss, and later by Harris and other prominent Corliss engine builders.

To the second class belong the half-moon valve gear, as used on the Reynolds-Corliss engine built several years since, and followed very frequently in many of the recent designs of this popular type of engine. The Reynolds-Corliss type is the more favorable and widely known because the old style crab-claw steam valve opens towards the centre of the cylinder, which is looked upon as obstructing the supply passages and forcing the steam to pass over and around the valves. This fault, if such it is, is overcome in the half-moon type, as the steam valve is usually made to open away from the centre of the cylinder. There is, however, no difference in the exhaust valves, they opening in either class, away from the centre of the cylinder.

The Corliss valve gear, in order to at once distinguish it from others, is termed a detachable valve gear and is called thus because the steam valves open positively and at the proper time by the direct action of the working parts of the engine, and continues to open until the connection with the working parts of the engine are broken by detaching or tripping the hook, by action of the cut-off cam.

When the steam valves are detached they are closed by the action of springs, weights, or more generally vacuum dash pots, thus cutting off the steam with a sharp, quick action. That this action may be fully understood, it would be well to study Figure 1, which shows an outline of a Corliss gear using dash pots (A & B) of the vacuum type for making the cut-off.

The time of cut-off or tripping is determined by the position of the cut-off cams, which are moved and controlled by the governor. Right here the question may be asked, do the cut-off cams trip the hook always at the same point? No; the cut-off is determined by the requirements of the engine load, hence its name—the automatic cut-off.

An understanding of the releasing mechanism may be had from Figures 2 and 3. Fig. 2 illustrates the various members of which the releasing mechanism is composed. The crank arm, which is keyed to and actuates the steam valve, is shown at A, at the lower end of which is the fixed pin carrying the sleeve B. The inner end of sleeve B terminates in two curved arms, b D, between the upper ends of which is the knock-off cam C, which is actuated by the governor through the rod C.

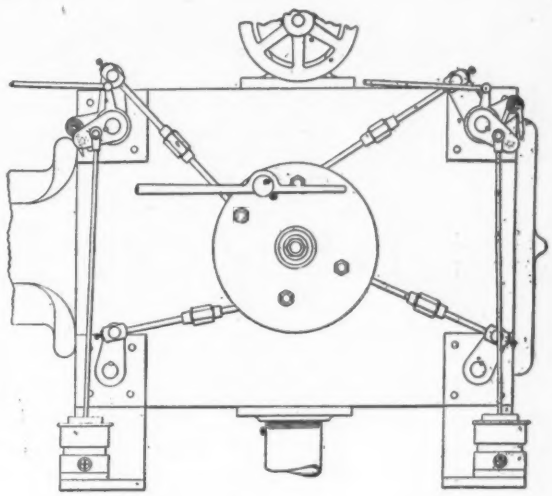


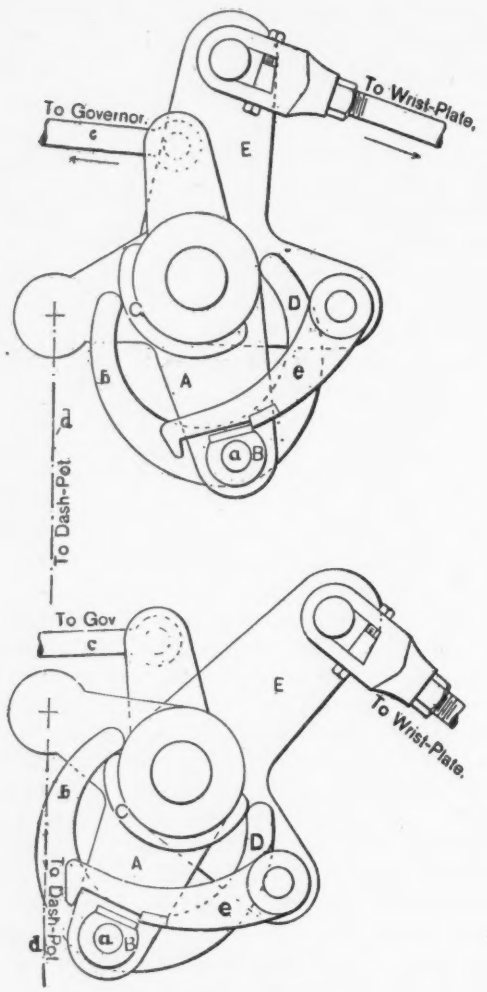
FIG. 1.

The crank lever E carries a pawl e which is held in place on the sleeve B. When the upper end of the crank lever E moves in the direction of the arrow, the lower end of the pawl e engages the sleeve B and carries it to the position shown in Fig. 3, when the curved arm D is brought in contact with the projection on the knock-off cam and pushes the arm D outward and pulls b inward turning the sleeve to the position indicated which releases the crank A, the latter being immediately returned to the position shown in Fig. 2 by the dash-pot and the rod at d. When the stop motion is in action the lever of the knock-off cam is moved in the direction indicated in Fig. 2, when the sleeve B is held at such an angle relative to the pawl that the latter is unable to engage it, so that the valves remain closed when the governor reaches its lowest position. The pawl is provided with a hook at its lower end which insures the closing of the valves should the dash-pots fail to act, or in case of the valve stems sticking.

The theory of the Corliss valve may be easily understood by considering the four valves as the four parts, or edges, of a common slide valve. The working edges of the two steam valves answering as the two steam edges of the slide-valve, and the working edges of the two exhaust valves as the exhaust edges of the slide-valve. As far as the setting is concerned the principle is the same; the only difference being in the adjustment; thus, the four working edges of the common slide-valve are in one solid valve, so that any change or adjustment of one of the edges interferes with the other three. If one edge is to be changed in preference to the others, it must be done by altering the valve itself instead of altering the set of the valve. The Corliss valves are, on the other hand, ad-

justable, each by itself, and any one of the valves may be changed without disturbing the other three, and, in fact, when the engineer is familiar with his engine and knows what changes are necessary, the adjustment may be, and is frequently made without stopping the engine.

In making changes in the Corliss valves it is well to remember that each valve represents an edge of a common slide-valve, viz.: Two steam edges, two steam valves, two exhaust edges and two exhaust valves. These are connected to the



FIGS. 2 AND 3.

eccentric and worked on the Corliss engine with the wrist plate, carrier arm, rocker arm and reach arm.

Besides giving motion to the valves, the wrist plate modifies the speed of travel at different parts of the stroke, in relation to each other, and gives a quick and constantly increasing speed when opening the steam valves, and a quick opening and closing of the exhaust valves.

The steam and exhaust valves travel slowest when they are closed.

The valves can be adjusted when the reach rod is unhooked from the wrist plate, and thus may be set properly independent of the position of the crank.

If the engineer has any knowledge, as he should have, of the ordinary slide-valve, and of the effect of "lap and lead," as applied to its working, and will consider the Corliss valve in that light, he will soon master the seeming difficulties in his way and find the Corliss gear to be the simplest, most perfect and most easily adjusted of all valve motions.

By using the following directions, any one may be sure of obtaining fair results in setting Corliss engine valves.

Begin by taking off the back caps or back heads of all four valve chambers. Guide lines will be found on the ends of the valves and on the ends of the chambers, as follows: On the steam valves, coinciding with the working edges of the valves; on the steam valve chambers, coinciding with the working edges of the steam ports. On the exhaust valves and ports, guide lines are also scribed in the same manner. The wrist-plate is central between the four valve chambers, on the valve gear side of the cylinder. A well defined line may be found on the stand which is bolted to the cylinder, and three lines on the hub of the wrist plate, which, when they coincide with the line on the stand, show the central position of the wrist plate and the extremes of its throw or travel. To adjust the valves, first unhook the reach rod connecting wrist plate with rocker arm and place and hold the-wrist plate in its central position. The connecting rods between steam and exhaust valve arms and wrist-plate are made with right and left-hand screw threads on their opposite ends, and provided with jamb nuts, so that by slacking the jamb nuts and turning the rod they can be lengthened or shortened as desired. By means of this adjustment, set the steam valves so that they will have from $\frac{1}{8}$ inch to $\frac{3}{8}$ inch lap depending on diameter of cylinder.

For the exhaust on non-condensing engines, set the line on valve and chamber to coincide. On condensing engines, the exhaust valves may have from $\frac{1}{8}$ to $\frac{1}{4}$ inch lap. Lap on the steam and exhaust valves will be shown by the distance between lines on the valves and the lines on the valve chambers.

If the engine has the half-moon, crab claw, or other gear which opens the valves toward the center of the cylinder, the "lap" on the steam valves will be shown when the line on the steam valve is nearer the end of the cylinder, and the "lead," when this line is nearer the center of the cylinder than the line on the valve chamber. The adjustment of the exhaust valves and the amount of "lap" and "lead" will be the same in either case.

Having made this adjustment of the valves, the rods connecting the steam valve arms with the dash pots should be adjusted by turning the wrist-plate to its extremes of travel and adjusting the rod so that when it is down as far as it will go, the square steel block on the valve arm will just clear the shoulder on the hook. If the rod is left too long, the steam valve stem will be likely to be either bent or broken; if too short, the hook will not engage, and consequently the valve will not open. Having adjusted the valves as stated, hook the engine in, and, with the eccentric loose on the shaft, turn it over and adjust the eccentric rod so that the wrist-plate will have the correct extremes of travel, as indicated by the lines on back of hub or wrist-plate. Then place the crank on either dead center and turn the eccentric in the direction in which the engine is to run to show an opening at the steam valve of from $\frac{1}{32}$ to $\frac{1}{8}$ inch, depending upon the size of cylinder and the speed the engine is to run. This opening or lead, like the lap above mentioned, will be shown by the distance between the lines on the valve and the lines on the valve chamber. This opening gives the "lead" or port open-

ing when the engine is on the dead center. The faster the engine is to run the more lead it requires, as a general rule. Having turned the eccentric so as to secure the desired amount of lead, tighten it securely, by means of the set screw, and turn the engine over to the other center, and note if the other steam valve has the same lead. If not, adjust by lengthening or shortening the connecting rod to the wrist-plate as the case may require.

To adjust the rods connecting the cut-off or tripping cams with the governor, have the governor at rest and the wrist-plate at one extreme of its travel. Then adjust the rod connecting with the cut-off cam on opposite steam valve so that the cam will clear the steel on the tail of the hook about $\frac{1}{32}$ inch. Turn the wrist-plate to the opposite extreme of travel and adjust the cam for the other valve in the same manner.

To equalize the cut-off and test its correctness, hook the engine in and block the governor up about $1\frac{1}{4}$ inch, which will bring it to its average position when running. Then turn the engine slowly, in the direction in which it is to run, and note the distance the cross-head has travelled from its extreme position at dead centre when the cut-off cam trips or detaches the steam valve. Continue to turn the engine beyond the other dead centre and note the distance of cross-head from its extreme of travel when the valve drops. If the distance is the same as when the other valve dropped, the cut-off is equal. If not, adjust either one or the other of the rods until the distances are the same.

By following these directions, the engine will do good work, but to know just what is doing, the engineer should use the indicator often. No engine room is complete without a good indicator, and no engineer can be well posted as to what his engine is doing and keep it in its best possible condition for good work without having an indicator and using it often.

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Management of Dynamos

By P. E. Moock

Read to the Ohio Society of Mechanical and Electrical Engineers

This article is not intended so much for the wise as for the novice. Speaking of management of dynamos, it always reminds me of the young man who, being put in charge of a dynamo worried a great deal, imagining there was something wrong or going to happen, finally wrote to his engineer friend for information and advice. His friend answered his letter, and, among other things said, if his dynamo was free from grease and dirt and the wires all properly connected he would have no more trouble with it than with a buzz-saw. This advice, though a dozen or more years old, has always served me a good purpose, as it helped to set forth the real simple construction of the dynamo.

We will take the direct current, low voltage, station generator, such as is used on the three wire system for lighting. In my experience four-fifths of all the attention necessary for the proper running of these machines—yes, I might say all machines, must be applied to the commutator. Let us stop for a moment and consider the simplicity of a dynamo. At least, in a mechanical way, there is nothing but a cylinder or a drum supported by two bearings with a pulley on one end by which it can be driven. This cylinder must be kept in the centre of rotation. This is very important, as, if the cylinder ran too close to the side caused by the pull of the belt, so as to cause the winding carried by it to touch at more than one place, it would be likely to arc and be the means of a very serious burn-out. Thus it is necessary to see that the bearings are not unduly worn, or if they should accidentally become so, they should immediately be replaced with a new one, or the old one taken out and repaired. To my knowledge several armatures have been burned out from this cause.

Returning to the commutator, it is absolutely necessary that it be kept nice and clean at all times. Some wirers say not to use sand-paper; others say that it is a good thing, but not to apply it too often. Now, as before stated, the commutator must be very nice and smooth, and, if necessary to keep it so, use sand-paper every time the current is off, but be sure and apply it with a concave block cut to a true circle of the commutator. Do not apply sand-paper while brushes are resting on the commutator, except in desperate cases. You probably have noticed that the commutator of all dynamos wears faster at either edge of the sedgement than in the centre, caused by sparking—not because of making and breaking the circuit, for the brush contact is wide enough to bridge across, but for the reason that copper wears away faster than mica, and, as the mica projects above the copper (just a little) each time the mica passes under the brush it is raised a trifle, thereby impairing the contact and causing sparking. This at first is very slight, but if neglected soon becomes worse and makes the commutator very rough and uneven. As each spark takes away a small particle of copper corresponding to the size of the spark, thus lowering the copper, and, as the mica is not affected by sparking, it remains high. Thus the process goes on until it ends in a lathe, only to be gone over again in the same manner. The remedy for this is the hollow block, vigorously applied, which practically cuts down the mica and smooths up the copper.

The brushes are next in importance to the commutator and should at all times be watched by the attendant. They should be placed so that they bear on a horizontal line lengthwise on the commutator and never allowed to spread out or fray over too large an area of the commutator, for if contact surface becomes too wide, a part of the current generated passes through brushes, thus unduly heating the armature. A good rule for woven wire copper brushes, such as are used on old style machines, is to trim both sides, and, as they wear away, turn them upside-down. On nearly all modern machines carbon brushes are used, and, if the brush area is large enough to carry the current without heating, there will be little or no trouble. However, it is very essential when first starting, to see that they are properly set at non-sparking point, the commutator cleaned frequently and that they bear properly on the commutator. This is best done by binding a piece of coarse sand-paper around the commutator, letting the brushes down on the same with the ordinary spring tension, and then slowly turning the armature. Carbon brushes should at no time carry more than thirty amperes to the square inch of contact area, while about 18 would be much better, and they should have a good contact solid to the brush-holder.

A good motto to hang over the dynamo is "Keep an eye on the commutator brushes."

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Do not hesitate to send in any idea which you think might interest your fellow enginers; we will always assist you in putting the artical in the most pleasing form possible, hence there is no reason, because of a possible lack of writing or drawing ability, for any one to desist from sending in their ideas.

An Error that is Not an Error

By R. T. Strohm.

The horse-power of a steam engine, we are told, is equal to the continued produce of the average mean effective pressure, the length of the stroke, the area of the piston, and the number of strokes per minute, divided by 33,000. The rule is correct, when it uses the average mean effective pressure of the two ends of the cylinder and obtains the total horse-power of the engine as a result.

However, when it comes to the calculation of the exact horse-power of each end of the cylinder, we cannot adapt the above rule. To change the term "strokes per minute" to "revolutions per minute," leaving the other factors the same, will not be sufficient, and will not give the precise horse-power of each end. Yet this is the rule which is given in nearly every engineer's handbook. The reason lies in the fact that the results obtained by it are very close to the exact results, and it is much easier and shorter to apply than the rule for the exact horse-power.

If it is desired to determine accurately the horse-power of either end of the cylinder of an engine, the correct rule would read as follows: Multiply together the mean pressure for that end in pounds per square inch, the length of the stroke in feet, the area of the piston in square inches, and the number of revolutions per minute, and divide the product by 33,000. The result will be the horse-power.

The difference between this rule and the one stated in the first paragraph of this article lies in the use of the different terms "net mean pressure" and "mean effective pressure." Now, in finding the total horse-power, if the rule in the first paragraph is used, a correct result will be obtained. If the horse-power of each end is found by means of the second rule and their sum taken, the result will be the correct total horse-power of the engine as before. But if the horse-power of the head and the crank end be found according to each of the two rules, the results will not agree for the same end of the cylinder, although the total horse-power in each case will be the same. The reason lies in the fact that the first rule when used to calculate the horse-power of a single end of the cylinder gives only an approximate result, whereas the rule in the third paragraph gives the exact horse-power.

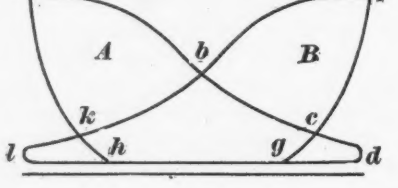

Fig. 1.

It may sound very contradictory to state that two different rules can give the same total result and yet not give equal partial results. Yet the fact remains, and it can be most easily shown by means of a few diagrams.

In Fig. 1 are represented a pair of cards taken from opposite ends of a cylinder. In order to obtain the mean effective pressure of the card *B*, for instance, we should divide the card into a number of equal parts and erect ordinates at the middle points of these parts. The average of these ordinates, multiplied by the scale of the spring, gives the mean effective pressure for card *B*.

However, note what has been assumed in doing this. The line *abc* represents the steam and expansion lines of card *B*. The distance of any point on this line from the atmospheric line represents to a given scale the pressure in pounds per square inch acting on one side of the piston, urging it ahead. The back-pressure or the pressure retarding the piston movement, is the pressure per square inch on the opposite side of the piston. Now, a single indicator cannot trace the pressures on both sides of the piston at one time. For convenience, we trace one card, and then the other over it on the succeeding stroke.

In calculating the mean effective pressure, then, we measure all the ordinates between the lines *abc* and *cda*. But notice that this assumes that *cda* is the back-pressure line showing the varying back-pressure on the piston, while the forward pressure varies along the line *abc*. This is an incorrect assumption. The line *abc* represents the varying forward pressure on one side of the piston during a single stroke. The line *cda* represents the back-pressure on the *same* side of the piston

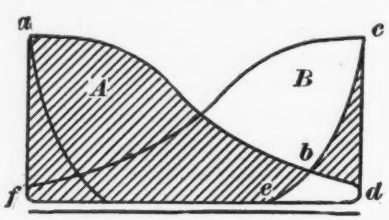

Fig. 2.

during the *succeeding* stroke. Therefore, an ordinate measured between the lines *abc* and *cda* at any point will represent the effective pressure correctly only when the back pressure at both ends is constant during the period in which both cards are taken. If the back-pressure should vary in the interval between the taking of the cards, the result would be inaccurate. This, however, is rarely the case. Nevertheless, the fault still remains, that an ordinate *mn*, for example, does not represent the effective pressure at the corresponding point in the stroke. For while the pressure at *m* is the forward pressure on the piston at that instant, the pressure at *n* is the pressure at the same point on the *same* side of the piston during the next stroke, whereas the ordinate *mn* should represent the difference of pressures on *opposite* sides of the piston at one given instant.

To find the exact horse-power of either end, it is necessary to proceed differently. Let card *A*, Fig. 2, represent the head end card, and suppose that it is desired to find the head end horse-power. We must first find the net mean pressure urging the piston ahead during the forward stroke and then substitute this in the rule given in the third paragraph. The method of finding the net mean pressure is as follows:

The pressure denoted by the vertical distance, at any point, between the expansion line *abd* and the back-pressure line *febc*, Fig. 2, is the net preesure at that point which causes the piston to move. At the beginning of the forward stroke this pressure is represented by the distance *af*. During expansion this falls until at a point *b* the forward pressure on one side is just equal to the back-pressure on the other side of the piston. After point *b* is reached, the back-pressure becomes greater than the forward pressure, until at the end of the stroke there is a net pressure represented by *cd* tending to retard the for-

ward movement of the piston. It is the inertia of the flywheel and the moving parts which keeps the piston from coming to rest at the point in its stroke corresponding to the point *b*.

Now, the area of the indicator diagram represents work performed. From the beginning of the stroke to the point *b* the forward pressure on the piston is greater than the back-pressure thereon, and consequently the steam does the work on the piston to the extent represented by the area *abefa*. Beyond the point *b*, the back-pressure is the greater, and the flywheel must give up some of its stored energy to overcome this back-pressure and keep the engine in motion. That is, the piston is forced to do the work on the steam which is confined in the compression space, to an extent represented by the area *cbdc*.

The work done on the piston by the steam is useful work. That done on the steam by the piston is not useful and is a loss. Therefore, on the forward stroke we have done useful work equal to the area *abefa* and have lost work equal to the area *cbdc*. So the net amount of useful work accomplished is equal the difference between these two areas.

This net useful work is accomplished while the piston moves through one stroke, and since the length of the card represents to scale the length of the stroke, if we divide the net useful work area by the length of the card we must obtain the ordinate representing the net mean pressure acting during the stroke. Hence we can formulate our rule to read thus :

$$\frac{\text{Area } abefa \times \text{area } cbdc}{\text{length of card}} \times \text{scale of spring} = \text{net mean pressure}$$

on the piston in pounds per square inch. This is for the forward stroke. For the return stroke we should use the same rule, but in connection with it use Fig. 3 instead of Fig. 2, as before. Having found the net mean pressure for each end, the separate horse-power may be calculated as indicated in the third paragraph.

If both cards were exactly alike we should obtain the same horse-power for both ends no matter whether we used the net mean pressure or the mean effective pressure. But seldom are the two cards precisely alike, and therefore, for either end, there is a difference between the mean effective pressure and the net mean pressure for that end. It is the net mean pressure which represents the exact average working force during the stroke, and not the mean effective pressure. And that is

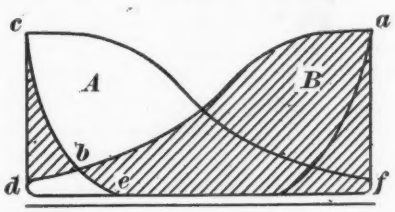

FIG. 3.

why the horse-power for either end when calculated by the use of the mean effective pressure for that end is not exactly correct.

Yet the *total* horse-power is the same by both rules. This is quite true, and it may be shown most clearly by means of areas, since they represent work. Consider the same cards *A* and *B* to be shown in all four figures. The useful work performed is represented by the sum of the areas of the separate cards *A* and *B*. In finding the mean effective pressure we use the area of each card. In finding the net mean pressure we use the net useful work area or area *abefa* minus area *cbdc* of each card. What we wish to prove, then, is that the sum of the areas of cards *A* and *B* is exactly equal to the sum of the net useful work areas found from Figs. 2 and 3.

Using Fig. 4, the area of card *A* conists of three smaller areas, or $abk + bkhgc + cgd$. The area of card *B* in like manner is $fbc + bkhgc + klh$. The net useful work area of Fig. 2, transferred to Fig. 4, is $alk + akb + klb + bkhgc - fdc$. The net useful work area of Fig. 3, transferred to Fig. 4, is $fdc + cgd + fbc + bkhgc - alk$. If the first two of these terms

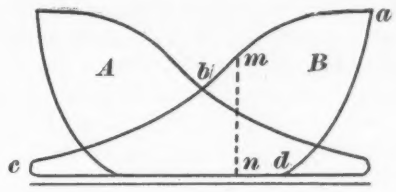

FIG. 4.

be added together, they will be found to give a sum precisely equal to the sum of the last two, and hence it is proven that no matter which rule for the total horse-power is used, the result will be the same.

As can be seen from the work given, it is much easier and simpler, as well as quicker, to find the mean effective pressure for each end than to find the net mean pressures, and hence the mean effective pressure is always used in ordinary calculations for finding the horse-power of an engine.

\+ \+ \+

Gas Engines For Fire Pumps

It is not altogether unusual to make use of gas engines for pumping purposes, but this has been done in equipping the pumping station of Philadelphia's new fire service for several reasons. Obviously, as the plant will only be in operation a short time at long intervals, it would be prohibitively expensive to employ steam-driven pumps. This would mean banked fires the year round and expense for fuel and attendance. Electric power is the only other serious competitor of the gas engine, and, owing to the possibility of the electric service being disabled by the breaking of wires in storms and the cutting of wires during fires, the gas engines appear to be the only motive power available which will meet the peculiar demands of the case. They are always ready for use at a moment's warning, the gas being supplied from the usual consumers' mains, and require but little attention and attendance and small expense of maintenance when not in actual operation.

Seven, three cylinder, single-acting gas engines of 280 horse-power each will be directly connected to 1200 gallon power piston pumps, working against a maximum pressure of 300 pounds per square inch. Two smaller engines of 125 horse-power will be similarly connected to 350 gallon power pumps. They will also drive electric ignition generators and air compressors. The function of the latter is to start the big gas engines. Air at high pressure will be stored in a reservoir and used to turn the 280 horse-power gas engine several times until the regular four-cycle gas propulsion comes into operation, when the full load may be applied. This unique pumping station is to be located at the corner of Delaware Avenue and Race Street and will take care of the popularly called "danger zone."

Heat Units and Degrees of Heat

By W. H. WAKEMAN

Listening to the conversation of engineers and firemen and reading their letters in some of the mechanical papers, shows that some confusion exists concerning the proper use of terms relating to heat, therefore a few lines in explanation seems to be in order.

Latent or hidden heat is known to exist, although we have no thermometer to indicate it, therefore we cannot refer to it as measured by degrees, as it must be expressed in heat units. For illustration, suppose that we take a piece of ice that is just about to melt into water, and ascertain the temperature of it by means of a thermometer. We find it to be 32 degrees Fahr., and immediately after it is melted its temperature is still 32 degrees. Now we know that heat has entered into the ice in order to melt it, although the ordinary instrument used for determining temperature does not tell us how much has been transferred.

Heat can be measured, for we are told that one heat unit will raise the temperature of 1 pound of water 1 degree. We are also told that the latent heat of ice is 142 or, in other words, 142 heat units have passed into the ice in order to melt it. It is not proper to say that it took 142 degrees, for the number of degrees as indicated by the thermometer did not change during the process.

This shows us that when we refer to the amount of heat required to melt ice, we must express it in heat units, but inasmuch as this term refers to a definite quantity of heat, we must also state, a definite of ice, and this unit of quantity is one pound.

From the above it is plain that in order to speak correctly we must say that the latent heat of ice is 142 heat units per pound, therefore, if we have a piece of ice that weighs 4.5 pounds, it will require 4.5x142=639 heat units to melt it after its temperature is reduced to 32 degrees Fahr.

A short time ago I was reading an interesting article on fitting up the piping in a mill for heating with exhaust steam. The writer knew how to arrange pipes to give good results, but when he stated that when steam at 212 degrees was condensed into water it gave up 142.65 degrees of heat, he very plainly showed that the theory of steam heating was not his forte. His short statement contained two errors, for the number should be 966 instead of 142.65, and it ought to be expressed in heat units per pound instead of degrees, as the latter term does not mean anything when used in this way, as already explained.

I once heard a man ask the following question: "How many heat units does it take to melt a piece of brass?" It is possible to answer this question, but more information is necessary. In the first place we must know the various proportions of other metals, which compose this brass, and, in the second place we must know how much the brass weighs. It is useless to even assume a case and calculate it, because the product would not be what the man wanted as he only wished to know the temperature of a fire that will melt a piece of brass. Viewing it in this light we see that the fire might consist of a shovel full of coal in a forge, or a furnace 10 feet square, full of live coals, as the term "temperature" does not take into account the quantity concerned, therefore, the weight of brass is not taken into consideration.

Some kinds of brass consists of a mixture of copper and zinc, while others contain copper, zinc and tin, but the proportions of these alloys vary according to the purpose for which the finished product is intended. If a piece of brass is put into a fire for the purpose of heating it so that it may be bent into some required shape, and it is left in the fire too long, so that it is partially melted, the temperature of fire required to do this depends on the proportion of metal which fuses at the lower temperature.

If it contains tin, which fuses at 422 degrees, it melts readily, but if it is composed of copper and zinc the latter will fuse at 773 degrees. If the whole is to be melted, the temperature at which copper fuses must be realized, and this is about 2,000 degrees.

When a piece of brass, or any other metal is melted, it does not prove the temperature of the fire, as it only shows that the temperature necessary to melt the metal was exceeded, and gives no clue to the excess realized.

If one pound of each of the above mentioned metals is melted, and we know the exact temperature required, that alone does not decide the number of heat units used, because the specific heat, also the latent heat of both metals must be taken into consideration, and, as they are not alike, the result will vary.

Suppose that for illustrating the case we take a piece of tin that weighs one pound. Its temperature is 42 degrees Fahr., and we put it in a ladle and apply heat until all of it is melted. When it begins to melt, the temperature is 442 degrees, therefore, the fire supplied 442–42=400 degrees. The specific heat of tin is .0562 then 400x.0562=22.48 heat units. To this must be added the latent heat of fusion for tin which is 25.6, making a total of 48 heat units supplied by the fire to melt one pound of tin.

The same process must be employed for any other metal, but the specific and latent heat will not be the same as for tin.

The results secured by the above rule are not strictly correct, because the specific heat varies at different temperatures, but this variation is so slight that the results are affected but slightly, therefore they are practically correct.

When 33,000 foot pounds of work are developed in an engine in one minute, the result is equal to one horse-power. One heat unit is equal to 772 foot pounds of work, therefore, for each horse-power developed, a certain number of heat units disappear, and this is determined by dividing 33,000 by 772 showing that the quotient is nearly 43. This means that for each horse-power developed 43 heat units disappear, and no way has yet been found whereby they may be recovered; but it is not proper to say that 43 degrees of heat have disappeared, under ordinary conditions.

If one pound of water was used to develop this power, and its temperature was reduced 43 degrees during the process, then we might say that 43 heat units have disappeared, but such desirable conditions will never be realized.

When we refer to a table of the properties of saturated steam, in order to find out the total heat at 100 pounds, absolute pressure, we see it stated at 1,184. It comes very natural to call this degrees, because the temperature of it is indicated by the thermometer, but the larger portion of it is latent heat, and this can only be expressed in heat units per pound, therefore when the total heat of steam at 100 pounds, absolute pressure, is mentioned, it means that one pound of it by

weight, contains 1,184 heat units above a temperature of 32 degrees Fahr.

In some calculations relating to steam engineering it becomes necessary to substract the heat units in a pound of feed water from the total heat of steam as above described. As zero of the Fahrenheit scale is 32 degrees below the freezing point, the number of heat units is usually stated above 32, therefore, it is proper to subtract 32 from the temperature of feed water, as usually stated, then subtract the remainder from the total heat of steam.

Suppose that we wish to know how many heat units are supplied by the fire under a boiler carrying 100 pounds, absolute pressure, where the temperature of feed water is 212 degrees Fahr. This water contains 212–32=180 heat units per pound above 32, and 1,184–180=1,1004 heat units.

If we add 32 to 1,184 and subtract the full temperature from the sum, the remainder will be the same as before, and the calculation appears more simple.

This apparent complication is caused by the fact that if we take one pound of ice at zero and apply heat, each degree in temperature that it rises in coming up to 32 degrees does not represent a heat unit, as the specific heat of ice is about .5, therefore, it requires only 32x.5=16 heat units to raise it to 32 degrees.

In order to melt this pound of ice at 32 degrees, it is necessary to add 142 heat units, which take the form of latent heat, as already described, then we have water at 32 degrees, which is the starting point usually adopted.

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Old Friends in New Clothes

PART VIII.

By A. EDWARD RHODES,

Author of Mechanical Drawing for Self-Instruction

An engineer friend of mine had some experience a short while ago, a knowledge of which may help some readers of The PRACTICAL ENGINEER who may run up against a similar problem.

Upon fixing the boiler in the morning, when the pressure got within 20 pounds of the point at which the valve should blow, it would give a spasmodic puff, sometimes of sufficient force to cause the weight to rebound two or three times, causing a succession of puffs, each ligher than the preceding one; then it would blow a little, just like a leaky valve, until blow-off pressure was reached, when it would act naturally during the remainder of the day.

One day the mill was shut down and my friend, John, being one of those progressive fellows that wants to know the cause and effect of everything, determined to find the cause which, when discovered, was "so simple," John said, "that it seemed any fool ought to have known what it was," but it had fooled several of us.

He began at the weight and worked towards the seat, and, when he got there the mystery seemed greater than ever. Finally, he put his hand into the opening and pulled up and the *seat moved;* then he pushed down and it moved back. The body of the valve was of the old style, urn shaped, and the seat was in a brass bush fitted down to a square shoulder or seat of babbitt metal poured around it and caulked down. There was nothing to hold this babbitt except a shallow grove around the casting, the brass seat was tapered up to hold it in place.

When steam was down, the weight on the lever forced the seat down sufficiently hard to cause adhesion of the rough surfaces so as to resist several pounds pressure. When the steam began to rise, acting on the increased area of the bush, it would raise the weight with considerable less pressure than that required when acting on the valve alone. Then the adhesion of the rough metals required a little more pressure to overcome it, and the steam would blow between the bush and iron, causing the puff that worried John. The soft metal would strike the top of the groove, and the pressure and weight being so nearly balanced, the weight would rebound, causing the succession of puffs. Finally a little increase of pressure would seat the soft metal permanently against the top of the groove in the casting, making the joint practically steam tight, and, at the proper pressure the valve would act as was intended.

THE CURE ATTEMPTED

The valve had been ground in and the soft metal caulked time and again, always with the same result; after a few days it would leak and act as before. A new valve and bush replaced the old ones—same result.

THE CURE EFFECTED

John made a drill a little more pointed than an ordinary drill, and drilled through the shell, babbitt and partly into the bush from opposite sides. He then fitted two pointed set-screws and screwed them as hard as he could without springing the bush, caulked the soft metal and ever since it has behaved as a safety-valve should behave.

DOES IRON EXPAND?

A few days ago I happened into a school-room when the professor was explaining the principles of expansion to a class; the apparatus used was so simple and cheap that I give it here

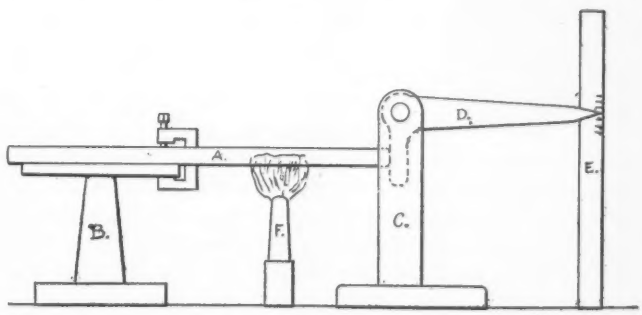

Fig. 1.

so that no engineer need be in ignorance as to the amount of expansion that takes place when iron is heated. Personally, I never before realized what a vast amount of distinction must take place when the surface of a body is unevenly heated.

The apparatus shown in Fig. 1 consists of A, a bar of iron about ¼" diam. by about two feet long. B, a table or stand to which it is fastened by a clamp, as shown. C is a frame, made with a pocket-knife, and supports a bell-crank lever D, one end of which is quite long and pointed. E is a common yard-stick, or a two-foot rule, and F is a strong heat, which applied in about the position shown, will cause the pointed end of the lever to move and show an amount of expansion in exact proportion to the length of levers.

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Atlantic City Council

Supreme Chief Clifford P. Williams and Past Supreme Chief Franklin R. Moore visited Atlantic City Council on Tuesday evening, September 2nd.

The Supreme Chief congratulated the Council upon its magnificent development, and urged continued and increasing devotion to the principles of the order. The Supreme Chief also endeavored to impress upon the Council the great importance and evident value of co-operating with her sister Councils in New Jersey, in their effort to secure the passage of an engineers license law at the coming session of the State Legislature.

Following adjournment the visitors were conducted to Workman's Hotel where a most excellent luncheon had been prepared.

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A Pleasant Evening in Germantown

At its splendid headquarters, on the corner of Main and Seymour Streets, Germantown Council No. 22, though but four months old, made a most successful debut as entertainers. The occasion was their first "Smoker," and not many besides their own members were present, but those who were, spent a most enjoyable evening. There were about sixty members of the Council and a dozen visitors in attendance, and from the time that Chief Engineer John P. Rickards rapped his gavel and in a nice little speech bade the visitors welcome, until a late hour, there was not a dull moment. Brief impromptu speeches were made by F. J. Armbruster, of Manayunk Council, and by T. D. Just and L. L. Rice, of The PRACTICAL ENGINEER. Brother "Billy" Doyle, with his violin, and Lyle H. Richards, who presided at the piano, kept the air filled with music throughout the evening. At 9.30 the committee in charge announced supper, and the menu presented would have done credit to a much more auspicious occasion. The tables were handsomely decorated and there was lots to eat—of the best—and plenty to drink, but nothing stronger than coffee.

When the inner man had been satisfied, there were pipes and cigars in abundance, more music and songs with a solo by Mr. Armbruster, and then a "stag" dance, which was amusing and even picturesque, causing more intense merriment than is customary upon such occasions, even when supplemented by "forced draft."

The committee in charge was composed of O. E. Kurtz, Wm. Doyle, John Brayman, Geo. Akroyd, John P. Rickards and J. J. Donohue. Brothers E. R. Whiteman, A. L. Jamison, C. Sonderberg and G. T. Lee also assisted.

Late in the evening some one announced that there were a large number of cakes, that had been donated by lady friends, and considerable fruit left over. It was suggested that these be auctioned off, and Chief Rickards was chosen as auctioneer. He succeeded, not only in getting good prices, but in causing lots of fun, all of which made a fitting climax to a delightful affair.

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Forging to the Front

Philadelphia Council, No. 7, of the American Order of Steam Engineers, which meets every Wednesday evening at the N. W. corner of Broad and Filbert Streets, is slowly forging its way to the front among the engineers' societies of this city.

Its membership is now nearing the hundred mark and growing steadily. The meetings are interesting and the attendance good.

The Council was never before in such good financial condition; they have had but little sickness and few deaths among their members during the past year, and the result is a fat treasury.

The members are ambitious to still further increase their number and new candidates are welcomed. The entrance fee is $3, and dues 15 cents a week; sick benefits $5, and $75 at death. Only licensed engineers are admitted. Those desiring further information should write to William S. Wetzler, 3707 Aspin Street, West Philadelphia.

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Lehigh Council's Third Birthday

The members of Lehigh Council, No. 15, of Allentown, Pa., celebrated the third anniversary of the Council on Wednesday evening, August 13. A large number of members and visiting friends were present. An excellent supper was served and the engineers comingled with each other and made merry. Among the visitors were the Hon. Jeremiah Roth and Peter Steckle. At the close of its third year the Council is in a very prosperous condition, both in point of numbers and financially.

Recording Engineer A. T. Strauss has not missed a meeting since the Council was started. Brothers John T. Lindstrom and Wm. R. Smith are keeping the boys interested with good educational work.

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Educational Committee, A. O. S. E.

JOHN MARTIN, Secretary, 2655 East Clearfield St., Phila.

The following questions are intended to create discussion in councils of the American Order of Steam Engineers. Answers will not be required by the Committee but prizes will be awarded by the Committee for the best essays prepared by individual members upon any of the questions asked. The PRACTICAL ENGINEER will give cash prizes for the best essays prepared by engineers whether members of the A. O. S. E. or not.

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Educational Committee

1. Is it preferable too feed water into a return tubular boiler, above the tubes or below the tubes through the blow-off pipe?

2. Is there any advantage in inducing a circulation through the blow-off pipe? Describe an efficient means of doing so.

3. Is there any advantage in the use of a surface blow-off pipe? Discuss the best method of supplying the same.

4. Is the use of a perforated blow-off pipe of any utility?

5. What effect has the formation of scale in a steam boiler upon its efficiency?

6. What is the best method of removing scale from the exterior surface of the tubes in a return tubular boiler, and also from the interior surface of the tubes in a water tube boiler?

7. What is the best method of preventing the formation of scale in steam boilers?

8. Does it pay to soften the water before it enters the boiler?

9. What methods are employed to soften water before it enters the boiler?

10. Will the use of a live steam feed water heater prevent the formation of scale, and is it an economical appliance?

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Work For You

[FOURTH LETTER]

PHILADELPHIA, September 15, 1902.

To the Individual Member of the American Order of Steam Engineers.

DEAR SIR AND BROTHER:—Equal, if not greater in importance, to the advisability of your lending a hand toward pushing forward the educational work of our Order, as well as exerting yourself to secure an increase in its membership, is the necessity of your regular attendance at the meetings of your council. I would therefore, ask you to carefully weigh the reasons herein set forth, as to why it is necessary that you should do so and also the advantages that would accrue to you should you recognize this necessity and endeavor to perform the duty it imposes.

The success of every organization no matter how constituted or for what purpose it exists, entirely depends upon the individual interest its members take in the conduct of its affairs. Investigate any of the great organizations of the day and you will find that the chief source of power which has elevated it to the commending position it occupies was solely derived from the enthusiasm and devotion of its members and the many sacrifices they have made to raise its standard higher and higher. If you are a member of such organization you know that what I say is the exact truth, then why not bring some of that devotion and enthusiasm into the service of the American Order of Steam Engineers? Which is of more value to you because it is bound by the closest ties to the very means by which you as an engineer earn your livelihood.

One of the easiest and at the same time one of the most effectual ways of displaying such enthusiasm and devotion is to attend the meetings of your council, because there is nothing that adds so much to the strength, solidity and success of an organization as well attended meetings. You feel encouraged to take an interest in the conduct of its affairs, and even become enthusiastic in futhering its progress, if you find a good turn out of your brothers present when you attend its meetings, but what is the result if, on the other hand you visit you council after a long absence and only find a few of the loyal ones there battling against the indifference of others? You will certainly become discouraged and ask yourself, what is the use of wasting your time to come here, when no one except these few think it worth while to be present, let alone do anything to benefit the council? Did it ever occur to you that you are individually responsible for whichever of these two conditions prevail in your council and it is for you to say which one will continue? There is nothing I know of that will cost you so little, as regular attendance at its meetings, and there is nothing that will go further to encourage others to attend and create that enthusiasm which is so essential to the success of our organization.

I know how great is the temptation to remain at home in the evening after your day's work is done, instead of going to the council. But if you are alive to the fact that your duty to the organization requires your presence there, you will put duty before the pleasure of idleness and have the satisfaction of knowing that your fideliiy will materially aid the progress and prosperity of our Order.

In speaking to some members of our Order of their neglect in this connection I have been offered the excuse that it is useless to go to the council because there is nothing to interest one there. I pity the brother who offers this old reason, yes; pity him; pity him because he is so hard to please and pity him because he is so selfish as to expect others to voluntary labor for his pleasure while he at the same time does nothing to encourage them. Fortunately for our Order there is a great number of its members who are not so selfish and who derive a vast amount of pleasure from their efforts to make the meetings interesting.

Again; I have also heard a personal dislike for a brother officer as an excuse for the same neglect. I freely admit to you that this is one of the hardest things to overcome in an organization and is one that does more to cripple its usefulness than anything I know of, because there is no accounting for a man's likes or his dislikes; it is simply a question of feeling and as such is not at all amendable to reason.

I have known of some members of our Order who devoted their time, talents and energy, without any hope of reward, toward its upbuilding, to be for no apparent reason so heartily disliked as to render a part of their efforts ineffective. If you do so, you should not allow personal antagonism to interfere with your duty to the organization; nor should you allow it to jeopardize its growth and usefulness. I know of no reason why you should permit a dislike for another member to keep

you from your council. In fact I am positive that it is your duty to ignore such feelings and by your presence show to your brothers that you consider the welfare of the organization to be paramount to any consideration of personal animosity.

In conducting this letter I would repeat that fortunately for our Order there is a great many of its members who derive a vast amount of pleasure from their efforts to make the meetings interesting and it is owing to such efforts that the organization is constantly growing in strength and adding to its influence for good. If you are not one of these; then let me appeal to you to attend the meetings. If you are one of these; then permit me to ask you to increase your exertions to induce the indifferent ones to attend. Seek them out, wherever they may be and show them that their neglect is detrimental to them as individual members and to the organization as a whole.

Attending the meetings should be easy and prolific work for you.

Fraternally Yours,

CLIFFORD P. WILLIAMS,
Supreme Chief Engineer.

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QUESTIONS AND ANSWERS.

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers with questions, he especially desires the readers in such cases to contribute any further information in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communications.

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Editor PRACTICAL ENGINEER:

Will you kindly publish in your columns a short treatise upon the amount of water contained in pipes of certain lengths, head pressure, the velocity in feet per minute, necessary to discharge a given volume of water in a given time, etc. A method of determining such matters is an absolute essential to the average engineer and your complying with my request in this matter I know will be appreciated by your many readers as well as myself.

Respectfully yours,

D. J. S.

Water Statistics and Conditions

A gallon of water (U. S. Standard) contains 231 cubic inches and weighs 8⅓ pounds.

A cubic foot of water contains 7½ gallons, or 1728 cubic inches, and weighs 62½ pounds.

The height of a column of fresh water, equal to a pressure of 1 pound per square inch, is 2.31 feet.

A column of water 1 foot high exerts a pressure of .433 pounds per square inch.

The capacity of a cylinder in gallons is equal to the length in inches multiplied by the area in inches, divided by 231 (the cubical contents of one U. S. gallon in inches.)

The velocity in feet per minute, necessary to discharge a given volume of water in a given time, is found by multiplying the number of cubic feet of water by 144, and dividing the product by the area of the pipe in inches.

The area of a required pipe, the volume and velocity given, is found by multiplying the number of cubic feet of water by 144, and dividing the product by the velocity of feet per minute. The area being found, the diameter is obtained by the table of areas.

Doubling the diameter of a pipe increases its capacity four times.

The friction of liquids in pipes increases as the square of the velocity.

The horse-power necessary to elevate water to a given height is found by multiplying the weight of the water elevated per minute, in pounds, by the height in feet, and dividing the product by 33,000.

Table of Pressure Due to Height

Feet Head	Equals Pressure per Square Inch.	Feet Head	Equals Pressure per Square Inch.	Feet Head	Equals Pressure per Square Inch
	0.34	...	.....	70	30.32
10	2.16	40	17.32	...	.....
15	4.33	...	.....	80	34.65
...	.....	50	21.65	...	.....
20	8.66	...	.....	90	38.98
...	.....	60	25.99	...	.....
30	12.99	...	.....	100	43.31

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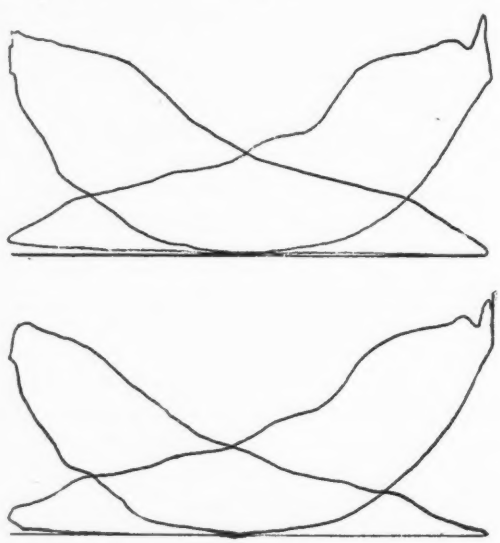
Editor PRACTICAL ENGINEER:

The enclosed cards are from a 14" by 14" Weston engine, having a one piece valve working between its seat and a pressure plate. What changes would you suggest to make the engine run more economical?



J. Moore.

In looking over cards we fail to find room for much improvement in the valve adjustment. The cards show different loads, but do not show any appreciable loss. The irregularities shown in the lines are due to vibrations of the indicator, Your compression might be a trifle less but you cannot change that without changing the exhaust to open earlier and the exhaust at present is correct. So to is the admission and cut off. Hence you are working under very good conditions and we would advise no change.

Editor.

Editor PRACTICAL ENGINEER:

I am a reader of your paper "The Practical Engineer," and would like you to kindly explain through your paper how to put in a fuse in case one burns out? Of what is the fuse made?

How can I tell if the current is on a feed wire in a building, and can I put the fuse in when the current is on?

JOHN KLEIDLEIN

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The operation of putting in a fuse depends upon the type of fuse used. You may use the regular fuse wire—which can be purchased in spools at any supply house—cut it into suitable lengths, bend eyes on the ends and screw into place. If a cartridge fuse is used, in case of a burn-out, remove the cartridge and screw in another through the slots, or eyes, provided in the fuse for that purpose.

There is no set size of wire for certain currents. All fuse wire is marked by the manufacturers as to its capacity in amperes and you will have to be governed by that. Whether the current is on the wire or not is usually determined by the use of an incandescent lamp, which, when attached to the wire, will, of course, give the result required.

The fuse can be attached with the current on, but it is not well to attempt doing so unless thoroughly familiar with such work—experience in this case being the only teacher.

Editor.

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Editor PRACTICAL ENGINEER:

Will you kindly let me know how many gallons of water a steam pump will deliver through a 6" pipe per hour, forcing it 12 miles, at 650 feet elevation, with two 8" plungers running 28 strokes per minute at *16" stroke* and how many H. P. will it take to do the work? A. Reader.

✣

Area of piston is 50.27 square inches.

Stroke of piston in inches is 16, hence volume of stroke=50.27 x .16=804.32, thus the total volume per minute of a single cylinder is 804.32x28 (the number of the strokes)=225209.6. The volume of both cylinders is 2x225209.6=450419.2. This divided by 231, the number of cubic inches per gallon=19498.6 the number of gallons pumped per minute.

The horse-power required=area of piston 50.27x1.33 (length) in feet of piston per stroke)—66.8591x28 (the number of strokes)—187205.48—volume in feet per minute.

With a head of 650 feet we have a pressure exerted of 281.45, (each foot in height equalling .433 lbs.) The volume in feet per minute 1872.0548x281.45 (the head pressure)= 526889823 total number of foot pounds pressure per minute against piston; consequently the horse-power required to balance this would be 33,000 (the standard foot pounds per horse-power per minute) divided by 526889823=1.596 the horse-power per single piston. The total=2x1.596=3192 add 25 per cent. to this and you have 3990 the total horse-power required, per minute.

Editor.

✣

Never open the fire doors to cool your boiler. Close the ash-pit doors and open the smoke-box doors in case you get too much steam, as opening the fire door causes too much contraction by the cold air cooling the furnace. It would be better to allow steam to blow off from the safety valve, which will not in any way injure the boiler.

LETTERS FROM ENGINEERS

In order to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories and general engine room experiences are especially solicited.

Grease versus Oil

Editor PRACTICAL ENGINEER:

Noticing the very interesting letter from S. L. H. under the above title, in the September number, and being somewhat upon record as an expert upon the subject of lubrication, I am going to take advantage of the opportunity to criticise the article, not for the mere sake of criticism, but in order to get truth before your readers on this subject of grease, as well as place myself in the proper position.

I have been quoted by some of the readers of The PRACTICAL ENGINEER as not believing in the use of grease as a lubricant under any circumstances. Such is not the case. I have always advocated using grease in the places where grease should be used. S. L. H. undoubtedly has just such a place. But, if practical, I would use in every instance where grease had to be used, oil as well as grease, for grease does not reduce the friction to the lowest minimum. It may be encouraging to some who think that the mention of grease to me has the same effect upon my mind as the waving of a red flag at a bull, to know that I have repeatedly recommended the use of grease as a lubricant; that I have just had grease cups placed upon three of the main bearings of my automobile. This is not because I want to reduce the friction to the lowest minimum, but because I do not want the chance of a hot bearing. Grease is a refrigerant; it produces lower temperatures; and it is fed to almost a certainty through a good compression cup. Now, what matters it to me whether I am using a quarter H. P. or more by using grease, if I am certain of getting home under my own power by using the grease. But remember grease does not increase frictional resistance; it reduces it, but not as much as the proper oil, so by using oil as well as grease on these main bearings I obtain the combined economic effect of the refrigerating properties of the grease and the friction reducing properties of the oil. I certainly would use grease upon the main bearings of every engine I had the opportunity to lubricate, but I would also use oil. If I could not use both, I would use grease alone, because the friction reducing properties of the oil are not sufficiently advantageous as the additional safety of the grease.

But S. L. H. made a bad break on the finish and said something he did not mean, but which confuse some of your readers. His closing sentence was as follows:

"Yet, if we have less heat in our bearings, we have a corresponding reduction in friction load of the engine."

How about starting up on a cold Monday morning, when every bearing throughout the whole place is cold; is the frictional resistance or load increased or decreased as the plant

warms up? Everyone knows that it will be late in the afternoon before the load is reduced to a minimum and that some mills keep steam heat through the mill over Sunday so as to avoid the waste power and other difficulties made necessary by the additional load caused by these cold bearings. Frictional loads do not increase or decrease in direct proportion to the temperature of the bearings of the lubricated parts. There is a certain point where the bearing works best. No bearings work best when cold; all work better when warm; none work best when hot. A warm bearing is desirable; a cold or hot bearing is undesirable. "Moderation in all things," as it were. Where is the engineer, who on starting up, has not said or thought, "Wait till she warms up and then she will run all right." S. L. H. has thought it many a time. He will be the first to acknowledge that my criticism is just, because his article shows that he is an intelligent, progressive and fair-minded man. Articles like his on grease, minus the last sentence, would do more to inform the engineers on the subject than any other method. Yours respectfully,

CHAS. EVERLY CARPENTER,
General Manager for E. F. Houghton & Co.,
Philadelphia.

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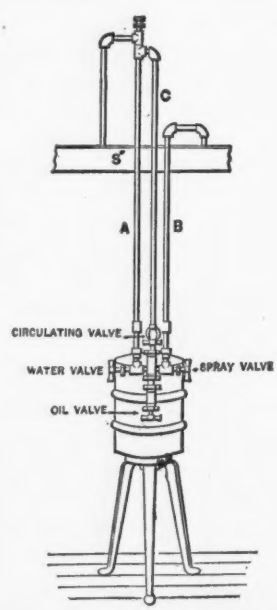
Cylinder Lubrication

Editor PRACTICAL ENGINEER:

In your July issue I read with much interest the article of J. T. M. on Steam Cylinder Lubrication and would like to state for the benefit of the readers of your valuable paper that two or more cylinders can be perfectly lubricated with economy by one lubricator. I am using a cylinder lubricator with a water circulating pipe that circulates hot water through the sight feed glass. This keeps the glass clean and insures a steady flow of oil. This lubricator also has a peculiarly constructed spray valve that was awarded a medal by the Franklin Institute as being a "properly formed valve for spraying oil." By its use the oil is thoroughly intermingled with the steam, forming an oily vapor which passes to the valves and cylinders —in other words, the steam is so thoroughly intermingled with the sprayed oil that it will lubricate wherever it goes, and will lubricate both high and low pressure cylinders. If a mineral oil is used that will with-stand the heat of the H. P. cylinder, by using this style of lubricator it would not be necessary to use a lubricator on each cylinder, in fact, the Mount Lookout Coal Co., at Wyoming, Pa., have one of these lubricators attached to a steam main oiling four 16x30x24" and two 14x25x36" compound pumps, two 10x30", two 6x18", two 8x12", two 12x16" and two 10x12",m aking 16 cylinders in all and besides the less amount of attention required for one in place of 16 lubricators to look after. They say that they are also saving 40 per cent. in the amount of oil used as the spray valve will only deliver as much oil as the amount of steam used will carry. You will, no doubt, agree with me that very often much more oil than is necessary is used, as you have noticed, no doubt, where the engine exhaust to the atmosphere the amount of oil separated from the steam, dropping all around the exhaust pipe.



As this lubricator is attached to the steam main, it will lubricate all the engine that takes steam anywhere from the main and prevent the steam pipes from leaking, as the steam is so thoroughly intermingled with the oil that in passing through the pipe, it will deposit a coating which will fill up the small crevices. This coating being elastic, will not crack with the expansion and contracting of the steam pipe, and will stop those annoying leaks that are so common in many engine rooms.

The accompanying illustration shows the manner of connecting the device to the steam main, marked "S."

GEORGE W. SMITH.

Wilmington, Del.

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An Unprecedented Stride in Education by Mail

THE AMERICAN SCHOOL OF CORRESPONDENCE AMALGAMATES WITH THE ARMOUR INSTITUTE OF TECHNOLOGY

It will no doubt be of great interest to the readers of "The Practical Engineer" to know that the American School of Correspondence, Boston, Mass., has completed arrangements with the management of the Armour Institute, Chicago, whereby the members of the faculty of that institution of learning will co-operate with the American School of Correspondence in the instruction of their students by correspondence. They will in the future be located on the premises of the Armour Institute, at Chicago, and in the future a considerable number of the faculty will be actively associated with the instruction of the correspondence scholars. Dr. Gunsaulus, President of the Institute, is chairman of the advisory board of the American School, and in that capacity signs all diplomas.

There is no doubt that this offers an opportunity of bringing college influences within reach of the masses such as no other form of education has made possible. In fact, it is University extension work in every sense of the word.

The endorsement of this school by the President of a regular Technical Institution, shows in a most striking manner the wonderful advancement in the standard of correspondence instruction in the past few years, and marks a new era in the educational possibilities of the people. Ambitious young men who are too poor to give up four years to obtain a training and degree at a resident school, can now considerably shorten their residence work by correspondence instruction. The students work being done under the members of the Faculty of the Armour Institute, their examination credits will be counted towards a degree at the Armour Institute, and they will be admitted to classes there in those subjects which they have passed by correspondence.

It is the plan to harmonize the correspondence instruction more and more with the regular resident work, so that the student may pass from one to the other with the least possible loss of time. Furthermore, the American School will make a systematic effort to assist their students to procure a position in Chicago and vicinity, and thereby enable them to attend

the night schools of the Armour Institute, offering as they do the same advantages in labratory and shop work as the daily and also a degree the same as the regular classes.

It is their aim to make every portion of their various courses as thorough as possible, and they are employing the most competent writers that can be secured for that purpose.

There are thousands of young men as well as older ones already iu business who would be glad to have the opportunity of taking up technical studies at home, in an institution of recognized educational standing, especially if their work would count towards a degree when followed by a year or two of study at a resident school. This is the field of the American School at the Armour Institute of Technology, and every effort will be used to raise the standard of correspondence instruction to such a degree of excellence, that their examination credits will be accepted by other schools besides the Armour Institute,and make such a Diploma stand for thorough work in the eyes of the manufacturers, and people employing trained technical help.

The American School in no way looses its identity by this change in location. It remains a separate institution under its own management, but with the co-operation and help of the President of the Armour Institute of Technology.

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A Reason for Employing Competent Engineers

The accompanying illustration will show the manufacturer a tangible reason for employing only competent engineers to operate his steam plant. The picture shows an eight-inch crank shaft taken from an ammonia compressing engine. The break—as can be seen—is the result of a flaw in the steel. The fracture did not occur until over a year and a half after the installation of the plant.

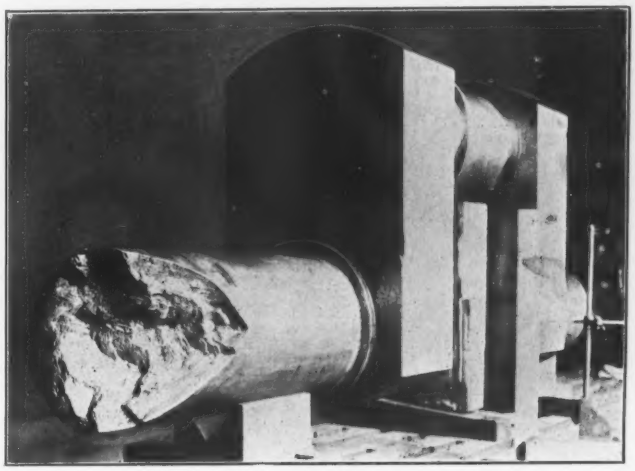
At the time of the installation of the plant the Company who were operating it determined to employ only the very best men obtainable—a feature which certainly saved them money in this case.

Their engineer before accepting the plant carefully examined the machinery and in doing so noticed a defect in the shaft which he reported, advising against accepting the shaft unless protected by a five year guarantee, this the manufacturers of the machine were loth to give, saying that the defect was only a scale in the metal. The judgment of the engineer was vindicated by the break occurring at the point in the period of time above mentioned. However, the manufacturer demurred—in spite of their guarantee—against replacing the shaft, claiming mismanagement upon the part of the operating engineer. In order to thoroughly satisfy themselves upon this point the Cooling Company decided to get the opinion of experts upon such work and obtained the services of Reilly & Fearon, 1160-1162 N. Third Street, Philadelphia, Pa.

The following fac-simile of their report further established beyond question the liability of the makers of the shaft, and also the foresight of the engineer.

PHILADELPHIA, May 17, 1901.

GENTLEMEN:—We beg to submit the following report of examination which we made of steam end of broken crank shaft from your engine. The part was removed to our works and placed on our level block. All centres were found, and lines drawn through same, with the result that the centre line of mainbearings on each side of crank pin were found to have moved ⅛ of an inch from the centre line on which the crank shaft was orginally constructed. This is caused by deviation from centre line in the crank pin, or in other words by the crank pin bending.



THE BROKEN SHAFT

This in the writer's opinion would be sufficient cause for the fracture or break which has occurred in the shaft. Consideration being given in this statement, to the quality of metal of which the shaft is made, as shown by reference to the accompanying photograph, which indicates want of homogeniety in the forging.

The same defect is apparent in the crank pin, and was in the writer's opinion, the direct cause of the fracture.

JAMES F. FEARON.

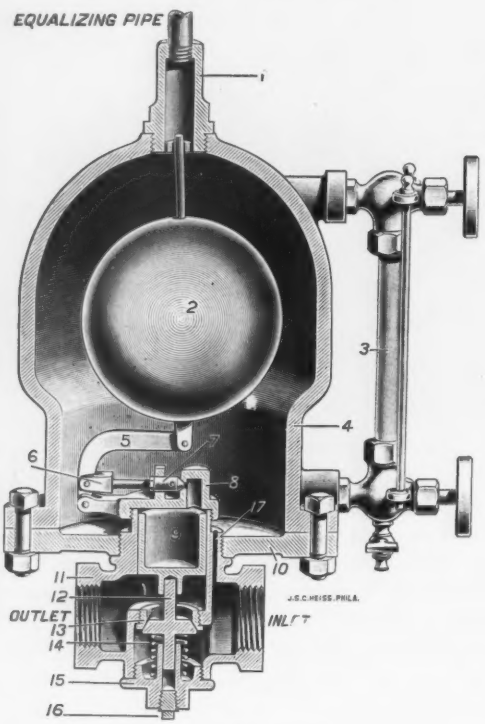
✦ ✦ ✦

The Bickel Float Steam Trap

There is a growing tendency upon the part of steam users to recognize the value of steam traps, and this is as it should be; there is probably no other attachment connected with the steam plant producing equally beneficient results in comparison with the money invested. However, despite the undoubted value of these devices there are still numerous places running without them. Indeed, some of our best engineers have not yet learned that a separator is of little practical value without a trap to carry off the separated water; but a study of the great lifting power of Steam in action will demonstrate that the moment any amount of water collects in the separating chamber, there is danger of the steam carrying it over to the engine cylinders in a lump. Thus it is easy to see wherein a trap, in connection with a separator, is not only convenient but is also essential.

In illustrating the value of traps one has only to show the saving of the water of condensation, entrainment and primage. Saving the heat contained in said water. Saving the engines from water, thereby insuring positively against accidents. Returning pure water to the boilers. Preserving uniform temperatnres, thus obviating difficulties due to expansion and contraction. Prevention of direct loss which usually exists from open drains, drips, tanks, etc. Enabling the engines to start promptly. Maintaining higher temperature at the end of long lines. Maintaining higher temperature in jackets, dryers, etc., and increasing the efficiency when steam is used expansively.

Hence in establishing the real economy in the use of steam traps we thus come to the point—what trap shall we purchase? This question while seemingly easy is not to be lightly passed over, for like everything else there are good and bad traps, and of course one only wants the good.



BICKEL STEAM TRAP.

The following description of the Bickel Float Steam Trap, which is shown in the accompanying illustration, will no doubt satisfy the reader of the merits of this device; it will respond instantly, has the full capacity of pipe connections, is not bulky or unsightly; the valves will not cut—they being of the rotating type—, and they are adapted for separators. By a study of the cut it will be noticed that the condensation enters the body of the trap at the connection marked "Inlet," and passes through the openings (17) into the float chamber (4). When there is sufficient water in the chamber to raise the float (2) the pilot valve (7) will open and allow the condensation to pass through the opening in the cylinder cap (8) into the cylinder or piston (9). This piston is fitted loosely in its socket so that the water, unless of unusual quantity, can pass around it and discharge through the outlet. However, if the condensation should come in larger quantities it will cause the pilot valve (7) to open wide forcing the piston (9) and the emergency valve (12) from its seat (13) thus allowing the condensation to pass directly through the body of the trap.

When sufficient condensation is discharged the float (2) lowers and forces the pilot valve to its seat where it remains until there is a further accumulation of water. This action must be positive for just so sure as the water enters the trap, so sure is the float bound to raise causing in its turn a corresponding action upon the other working parts of the appliance and in that way ensuring a certainty of results. For further description and other data write FRED F. BICKEL, 1348 Palmer Street, Philadelphia, Pa.

The Moore Water Tube Boiler

With the days of high steam pressures and the desire for superheated steam comes the demand for boilers of such design and mechanical construction as will guarantee a certainty of sufficient strength combined with the highest degree of economy. In making a selection of a boiler for steam purposes it will be well to recognize the fact that the boiler which would have answered a number of years ago cannot be expected to meet the requirements of the changed conditions.

The tendency of our times is for high pressure steam, on account of the great economy that is found in compounding engines, and in those which use the steam with triple and quadruple expansion.

In order to accomplish the desired economy, high steam pressure must be maintained on the boilers. This can be accomplished with any degree of safety only by the use of a sectional boiler.

However, the bare fact of it being a water tube boiler is not always a criterion in favor of absolute safety.

The constructions of water tube boilers we see put into use, in some instances really make some of the boilers dangerous, and others very annoying, on account of the frequent repairs required to keep them in order. Such boilers are often constructed by men unacquainted with all the requirements of a steam boiler; they seem to imagine that all that is wanted of a steam generator is to boil water quickly, and for safety, divide the parts and stick them together. Hence we find patent attorneys, sewing machine builders, phosphate manufacturers, moulders, defunct foreign navy engineers, and even some boiler makers, who are teeming with ideas about boilers, and confident of their ability to build a steam boiler to carry any amount of steam pressure. Is it any wonder that their boilers are not acceptable to the engineers of the country on account of their faulty design, even when the workmanship is first class, as it frequently is?

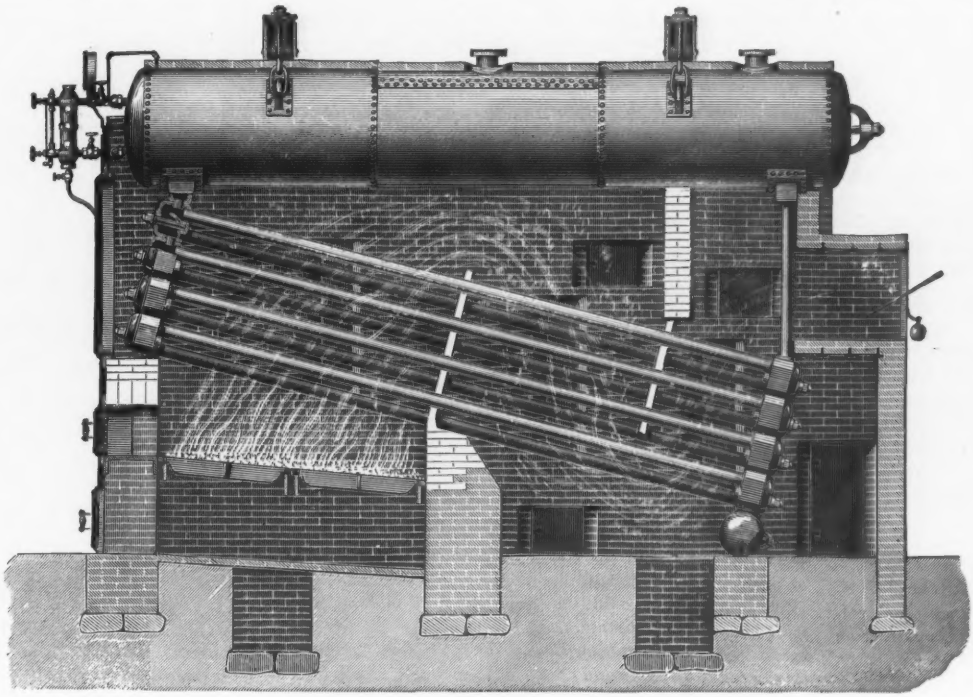
Hence the conclusion to be drawn from the above by steam users, mechanical engineers, architects, and engineers who have the care of steam plants, is that when about to make a selection of a steam boiler the first thing to ascertain is, who constructed the boiler, and what are the claims of such construction? See if these are true and don't conflict; then the material used in their manufacture and workmanship may be considered.

The accompanying illustrations show the Moore Water Tube Boilers which are manufactured by the E. J. Moore Foundry and Machine Works, 2227-2233 Wood Street, Philadelphia. A careful student of the method of construction will find many points to recommend in this boiler.

In the Moore boiler together with a proper division of its parts, obtained through the inventors years of practical experience, will be found freedom from rupture, immunity from explosion, economy of fuel, a perfect circulation, large capacity for both water and steam, provision for expansion, easy access for examination and cleaning, exemption from using cast heads and the lessening of the cost in production, consequently a lessened cost to the consumer.

This boiler, while undergoing constant improvements, is so well known to the steam users of both this country and Europe that a detailed discription would be superfluous. However, the following points found in this boiler will satisfy the prospective purchaser of a water tube boiler of its reliability.

By increasing the thickness of plates in the drums, steam pressures can be safely carried on the boiler up to 300 lbs. They will relieve at 350 pounds and close at 310 pounds, and keep tight at the latter pressure. Any one can see the utter impossibility of exploding this boiler by internal pressure of any kind. The plates will relieve at the rear end first, as there are four pounds more pressure there on account of the height of the column of water in the boiler. The sections are clustered together, five wide and four high, and are united to a large saddle in front by means of expanded nipples or short tubes, so that very little friction retards the flow of the intrained water and steam, in their passage to the upper drums to complete is the round of circulation. These saddles are riveted to the upper drums on the under side back from the heads; the interior of the saddle is open full size, except that the openings are ribbed for strength. There is another saddle at the rear end, situated back from the heads of the steam-and-water drum having a sufficient number of circulating tubes expanded therein and connected by expansion to the back sections. This construction gives a free run of all the sediment down to the mud drum or lowest point of the structure.



THE MOORE SAFETY WATER TUBE BOILER.

The upper horizontal drum for 100 horse-power is thirty-six inches in diameter by nineteen feet long, made of open hearth steel, five-sixteenths of an inch thick, horizontal seam, double riveted heads, one-half inch thick, dished to the radius of the diameter of the drum.

There are no cast-iron heads, braces or stays in its construction, except a man-hole plate, sixteen inches by eleven, to give access to the interior.

The whole boiler is erected on wrought-iron columns and channels; the columns are fitted into cast-iron base plates, twenty-four inches by twenty-four inches, with flanges that overlay their foundations, and thus secure the brick side-walls in position; the over-head channels are connected to the column by means of caps and bolts. Between these channels, eyebolts with links extend down on each side of the drum; the links are passed over trunions or hooks that are riveted to the side of the drum. This arrangement for the suspension of the whole steam boiler, with its weight of water and material, is so evenly distributed that when the boiler is erected and filled with water, and ready to be tested before bricking in, it is so sensitive to touch that the whole structure can be moved by one hand. By this link motion, expansion and contraction are well provided for, and this prevents rupture.

Catalogue and further description can be had from the above address.

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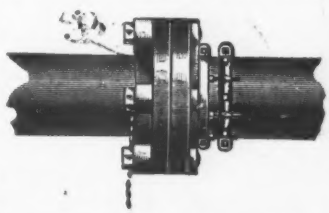
Of Interest to Power Users

Utilization of steam, gas, vacuum, air, ammonia and water about a manufacturing plant requires considerable pipe from the boiler or engine room. In many cases these pipe systems are exposed to the weather and the joints become rusty, and, in time leaks are produced. Instead of having to stop the system while a particular length of pipe is removed and a new one inserted, it is claimed by the manufacturers that your troubles cease with the use of the Perfection Leak Closing Clamp, illustrated herewith.



It is claimed that this clamp will effectually stop any leak at an elbow, tee, flange, valve or fitting on any pipe, and at a cost less than the labor alone for removing the defective pipe, and without any stop or delay.

The method of application is shown in the cut illustrated in the advertisement of F. A. Nusbaum, its patentee, 950 Washington Street, Dayton, Ohio, to be found in this issue.

TRADE NOTES

A drop of oil at the right time is better than a quart, and the drop costs less. A most admirable and efficient device for lubricating a number of cylinders with perfect regularity is the Lackawanna Lubricator. If you are not familiar with it, you should write for illustrated circulars to Chas. A. Smith, Jr., P. O. Box 478, Wilmington, Del.

With every order for "King Packing," you get a spring roller vest packet measuring tape, specially made for measuring piston and valve stem packings, free of cost. For further particulars, catalogue, etc., address, the Delaware Electric and Supply Co., 217 Shipley Street, Wilmington, Del.

The Keystone Elevator Inspection and Repair Co. has recently been incorporated to do a general elevator business. They have established offices and works at the Northwest corner of Eleventh and Wood Streets, Philadelphia, and are now prepared to execute orders promptly. Their shops are fully equipped with the latest and most improved machinery, and they have secured the services of a force of thoroughly trained and expert elevator men who are familiar with all styles of elevators and every branch of elevator construction and repair work.

For the time being the Company intends to make repair work its leading feature, and every effort will be made to give prompt and efficient service in this line.

The officers of the Company, Mr. John J. Sproul, general manager, and Mr. W. J. Greenhough, secretary, are both experienced elevator men, having been with Stokes & Parrish and the Moorse Williams Co. for the past sixteen years.

Engineers needing repairs to their elevators will do well to give them a trial.

The Burt Mfg. Co., of Akron, Ohio, recently received a cable order for a large number of their Cross Oil Filters, to be shipped to St. Petersburg, Russia. Other export orders were shipped by them last month to England, Portugal, Japan and Argentine Republic.

T. T. Burchfield Co., 619 Arch Street, Phila., have recently installed three new Watertown engines at the Hamilton Court Apartments, 39th and Chestnut Streets, Phila., aggregating 380 H. P., direct connected to C. & C. dynamos.

The Cherry Chemical Co., one of the best known manufacturers of water purifying chemicals and boiler compound in the country, have recently increased their facilities for manufacturing, and are now filling orders promptly. Their offices, at 1215 Filbert Street, are unusually busy, and they report a rapidly increasing demand for the well known Red Seal Boiler Compound.

A new catalogue has just been published by the Crandall Packing Co., Palmyra, illustrating and describing a large variety of packings for almost every conceivable packing contingency. This catalogue is more complete and comprehensive than any previously issued by this Company, and the Company is anxious to place one in the hands of each of our engineer readers upon request so to do.

A new catalogue has just been issued by Jas. McCrea & Co., 67 West Washington Street, Chicago, Ill., its worth having, and each of our engineer readers should send for a copy without delay. Among the specialties which are handsomely illustrated and ably described, are the well known Climax Steam Joint Clamp, the H. H. Steam Trap, Butman Flue Cleaner Rod, the Century Gasket and Washer Cutter, an effective and cheap device, worth much more than it costs, and the Century Drilling Machine, for drilling pipes or other metal with a brace bit. The Robert's Boring Machine for electric wiring is also a novel and very useful device.

Hartford Engine Works, Hartford, Conn., have purchased the special tools and patterns of the late E. H. Judd, who built the Woodruff & Beach engines. This will enable the Hartford Works to make quick repairs or furnish part of these well known engines without much delay. Owners of these engines should make special note of this, as it may save them a great deal of trouble.

The Hartford Co. have sold a number of their own make of engines recently, but still have a few on hand and ready for delivery, ranging in capacity from 10 to 75 H. P. each.

Cross Oil Filters

Save Half on Lubricating Oil Bills

"OUR ENGINEER ESTIMATES that we have saved about 75 per cent. of our engine oil for use the second time with your CROSS OIL FILTER.

We cannot advise just how much this will amount to in dollars and cents, but consider that the Filter is giving good satisfaction."—AMERICAN TUBE AND STAMPING CO., Bridgeport, Conn., Sept. 11, 1902.

Cross Oil Filters are guaranteed to reduce lubricating oil bills, at least, 50 per cent. Let us send one on 30 days' trial, to be returned at our expense if it doesn't satisfy

THE BURT MFG. CO., Akron, Ohio, U. S. A.

Largest Manufacturers of Oil Filters in the World

Cross Oil Filters carried in stock by the

FAIRBANKS CO.

Sole Agents for Philadelphia

THE POSITIVE EXPANSION BOLT

Special Discount to Jobbers. Write for Prices

Manufactured by **D. C. SEAMAN & CO.**

1638 Hutchinson St., Philadelphia, Pa.

For sale by Neal & Brinke, 18 Warren St., New York; Somers, Fiths & Todd Co., 323 Water St., Pittsburgh, Pa.

IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics. JOHN T. LINDSTROM, 440 Liberty Street, Allentown, Pa.

YOUR BELTS

YOU DON'T WANT TO RUN TIGHT BELTS, DO YOU?

YOU HAVE TO. WE KNOW YOU DON'T BELIEVE IN BELT DRESSINGS.

WE DON'T BLAME YOU.

BUT YOU WILL BELIEVE IN CLING-SURFACE if you will investigate what it will do.

It penetrates a porous belt and leaves the surface clean—not sticky.

It preserves the belt, stops all slipping, so the belt can run easy under full load. This isn't what we say, it's what our customers say. We will show you if you wish. Get a package, test it, pay only if satisfactory.

CLING-SURFACE MFG. CO.,

185-191 VIRGINIA ST., - - - BUFFALO, N. Y.

NEW YORK—39-41 CORTLAND ST.

PHILADELPHIA—THE BOURSE.

J. C. McNelley

McNELLEY'S

AMERICAN BOILER COMPOUND

We are one of the largest manufacturing chemists in the world making a specialty of boiler cleansing compounds. Our compound is the result of years of experiments by an engineer of long experience, assisted by expert chemists. American Boiler Compound not only completely removes all scale and incrustation in the boiler, but prevents new from forming, and will, if properly used, keep the boiler absolutely clean and free from all forms of corrosion, such as pitting, grooving, honeycombing.

Send Sample of Water and Sample of Scale if Convenient

We will be pleased to hear from engineers who will secure trade for us. When writing for information address J. McNelley, Department Manager, 35 Poplar Street.

SMITH, KLINE & FRENCH CO.

429-435 Arch Street, Philadelphia, Pa.

John R. Livezey, general agent for Nonpareil Cork Pipe Covering, has opened a branch office in Pittsburg, in the Builders' Exchange Building. This office is in charge of Mr. Guy L. Andrews, and they are already getting a large share of Pittsburg business. They are insulating all the steam pipes in the new P. R. R. Union Station Power House. They also have a large order from the Wm. Harris Forge Co., of Allegheny, and their water pipe covering has been specified for the new Farmers' Trust Bldg., which is 24 stories high. Their sheet cork is being used for the new morgue, under construction for the City of Pittsburg.

The American Water Softener Co., Harrison Building, Philadelphia, have had one of their Water Softening Machines in operation at the steam plant of the Philadelphia Pneumatic Tool Works for several months, and, upon opening the boilers recently absolutely no scale was found. Catalogue and description of this machine will be mailed to any one interested.

Lindstrom's Separators for inside of boilers are meeting with decided success. Mr. Lindstrom informs us that his orders are increasing every month and that they are not only proving a factor of safety, but are showing great economy on account of the large percentage of moisture which they extract from the steam. Catalogue may be had by writing, John T. Lindstrom, 440 Liberty Street, Allentown, Pa.

WANTED

WANTED, an Engineer with large acquaintance in Philadelphia and vicinity, member of the American Order of Steam Engineers preferred, to solicit trade for Packing and Engineers' Supplies. Address, W. D., care "The Practical Engineer," 1215 Filbert St., Philadelphia.

ENGINEER, having had four years' experience in refrigerating and ice making and fully capable to take charge of any plant, is open for a position. Highest reference. F. H. G., care "The Practical Engineer."

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"That no scale shall form in boilers," is the significant title of an exceedingly pretty booklet describing the Sorge-Cochrane system, for the thorough heating and purification of water for boiler feed and other purposes by simple chemical and mechanical treatment. This method, which is new, is the product of the Harrison Safety Boiler Works, 3144 North Seventeenth Street, Philadelphia. A copy of the booklet will be sent free upon request. The Company have also issued a neat booklet describing the Cochrane Feed Water Heater.

Never before have the Direct Separator Co., of Syracuse N. Y., been so busy as at present, and in this the Company feels that their claims of the superiority of Sweet's Separators are amply vindicated. They are also making a large number of exhaust heads and steam traps. Their catalogue, which will be mailed free upon request, is a valuable addition to an engineer's library.

Jas. Bonar & Co., Carnegie Bldg., Pittsburg, Pa., have issued a handsomely illustrated new catalogue describing the Bonar Steam Trap. This trap is new and something of a novelty in trap design, but it embodies only simple and well proven mechanical principles which, together with a strong and positive action, make it well worth investigation. A copy of their catalogue will be mailed to readers of The PRACTICAL ENGINEER upon request.

An Oil Filter is an inexpensive device, but in many cases it pays the biggest dividend on the investment of anything about a steam plant. This is especially true where even a moderate amount of oil is used, and the filter is a good one.

The "Famous" Filter, built by the Liberty Mfg. Co., Pittsburg, Pa., has several points of merit that should be investigated by anyone contemplating the purchase of a filter. A catalogue will be mailed for the asking.

POWER and high speed in modern machinery depend upon perfect lubrication. It is the solid lubricant that has made this possible. It is Dixon's Flake Graphite that has provided the best solid lubricant.

Send for Circular and Sample.

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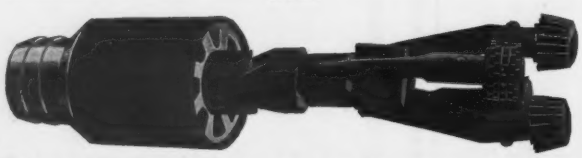

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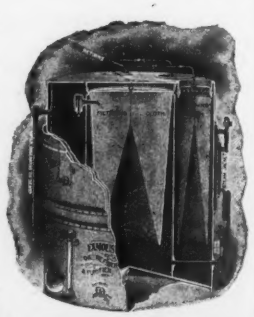

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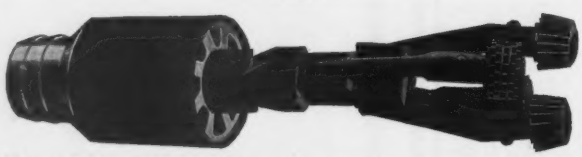

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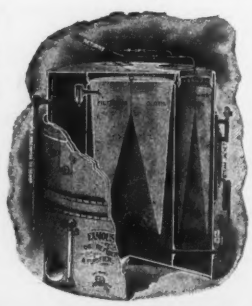

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FREE—Our patent steel packing rule saves engineers labor, time, trouble, temper, packing, burnt fingers and swear words. It is worth $1.00 Sent absolutely FREE to engineers who order from us enough "P. P. P." for a trial, if they mention this paper.

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Manayunk Council, No. 9, meets second and fourth Friday evenings in Temperance Hall. Chief Engineer, Richard Wallace. Corresponding Engineer, John Clevenger, 211 Lofty Street.

Helping Hand Council, No. 12, meets every Thursday evening at Kensingon Ave., and C Streets. Chief Engineer, Edward Laurence. Corresponding Engineer, Frank McHugh, 2508 Tulip St. All correspondence should be addressed direct to the Council.

Municipal P. F. D. Council, No. 20, of Philadelphia, meets the second Thursday of each month at Odd Fellows' Hall, Third and Brown Streets. Chief Engineer, Frederick Markoe. Corresponding Engineer, Walter Meyers, 1211 North Howard Street.

Pittsburg.

Iron City Council No. 21 meets every Saturday at 1070 Fifth Avenue. Chief Engineer, Phillip W. Sutton. Corresponding Engineer, F. C. Rose, care of St. Paul's Orphan Asylum, Idlewood, Pa.

Girardville.

Girard Council, No. 8, meets every Tuesday evening at O'Neill's Hall, 2nd and Ogden Sts. Chief Engineer, Jacob Weber. Corresponding Engineer, M. J. Carey, Lock Box 214.

Allentown.

Lehigh Council, No. 15, meets every Wednesday evening at 639 Hamilton St. Chief Engineer, Wm. R. Smith. Corresponding Engineer, A. P. Driesbach, 728 Chew Street.

Pottstown.

Pottstown Council, No. 14, meets first and third Saturday evening at P. O. S. of A. Hall. corner High and Hanover Sts. Chief Engineer, Joseph Rhoads, Corres., Engineer, H. L. Shirey, 862 Cherry St.

Reading.

Progress Council, No. 18, meets every Saturday evening at Diebert Hall, 9th and Penn Sts., Room 4. Chief Engineer, Geo. W. Miller. Corresponding Engineer, Frank S. Miller, 3 W Franklin St.

Chester.

Delaware County Council, No. 6, meets every Wednesday evening in the Carpenter Hall, 6th and Wall St. Chief Engineer, John Canavan. Corresponding Engineer, E. E. McCoy, 2222 West 3d Street.

York.

York Council, No. 16, meets every Wednesday evening in the Jordan Block. Chief Engineer, A. L. Bair. Corresponding Engineer, Walter H. Long, 23 East Philadelphia Street.

Harrisburg.

Capitol City Council, No. 17, meets every Tuesday evening in Red Men's Hall, Market Street, above Second. Chief Engineer, B. H. Shafer. Corresponding Engineer, S. Filson, 1126 Market Street.

Columbia.

Columbia Council, No. 18, meets every first and third Saturdays, in Odd Fellows' Hall. Chief Engineer, Ruben Beard. Corresponding Engineer, W. J. Courtney, 804 Walnut Street.

Sunbury.

Sunbury Council, No. 19, meets every second and fourth Saturday in Zartman's Hall. Chief Engineer, S. E. Lees. Corresponding Engineer, Ed. Schrieber.

WISCONSIN.

Deputy Supreme Chief Engineer, Joseph P. Harris, No. 1611 Clybourn Street, Milwaukee.

Milwaukee.

Washington Council, No. 1, meets every Saturday at 207 Grand Avenue. Chief Engineer, J. B. Chambers. Corresponding Engineer, James A. Rigby, 136 Reed Street.

Clifford P. Williams Council, No. 2, meets every Thursday evening 298 4th Street. Chief Engineer, David T. Richardson. Corresponding Engineer, Jas. T. Harris, 1611 Clybourn Street.

TENNESSEE.

Deputy Supreme Chief Engineer, John B. Mullen, 826 Central Ave., Nashville.

Nashville.

Enterprise Council, No. 1, meets every Friday evening in the Twin Building on Cedar St. Chief Engineer, J. J. Johnson. Corresponding Engineer, Jno. B. Mullen, 209 Jackson Building.

OREGON.

Deputy Supreme Chief Engineer, Nat Freese, Grant's Pass, Oregon.

Grant's Pass.

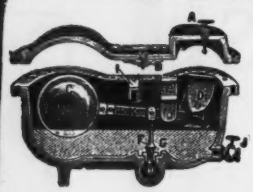
Oregon Council No. 1. Chief Engineer, William H. Kenny. Corresponding Engineer, Nat Freese. Meets every first and third Saturday. A. O. U. W. Hall, Main St.

TEXAS.

Deputy Supreme Chief Engineer. S. A. Bisbery, care of Cotton Compress and Warehouse Co., Galveston.

Galveston.

Galveston Council No. 1 meets every second and fourth Tuesday evening at Engineers Hall, So. West corner 22nd and Strand Streets. Chief Engineer, Max Levy; Corresponding Engineer A. L. Bradford, Union Depot.



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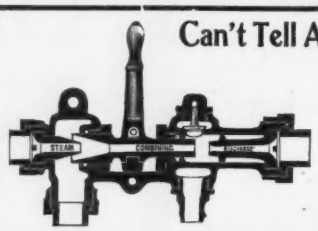

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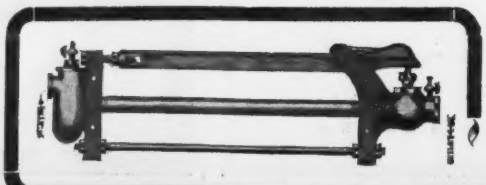

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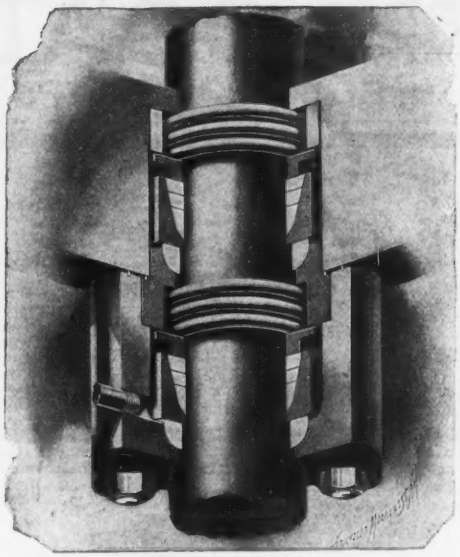

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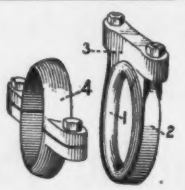

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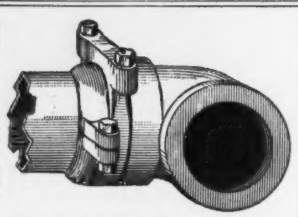

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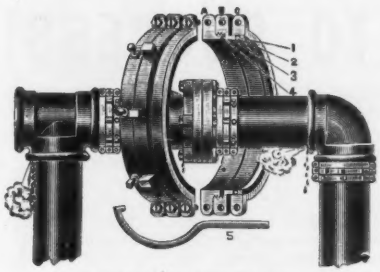

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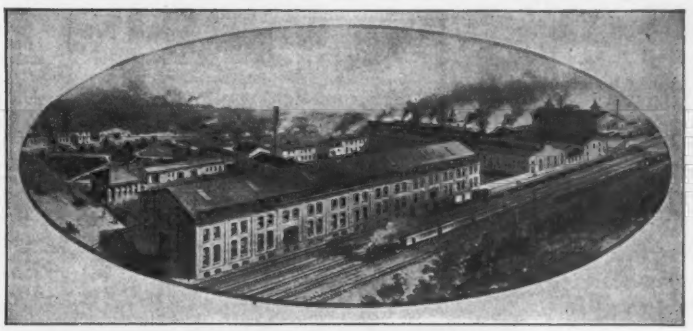

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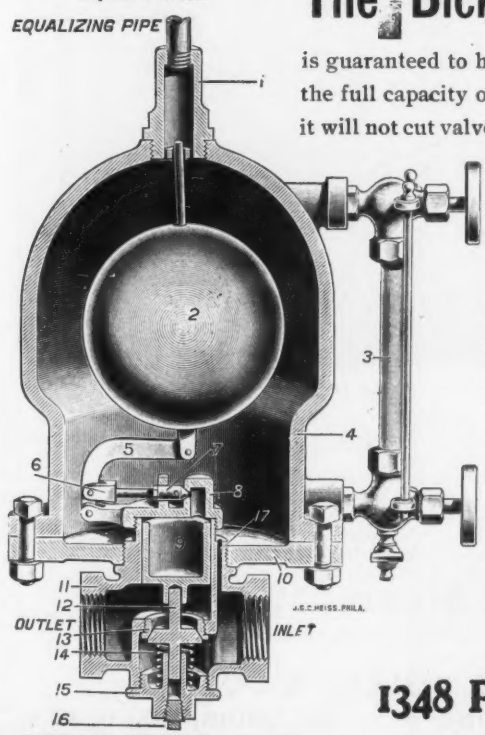

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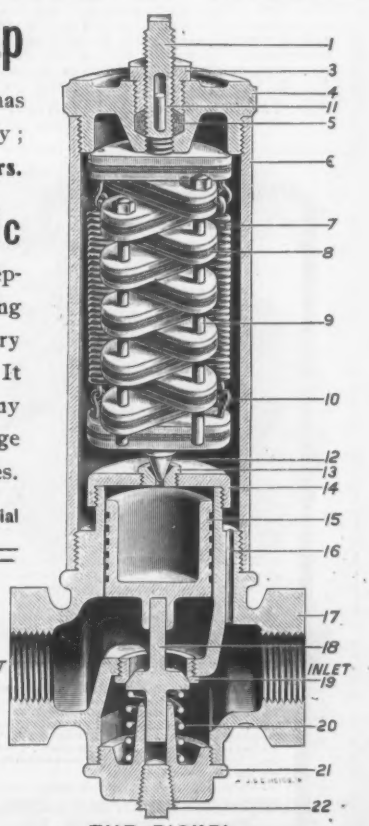

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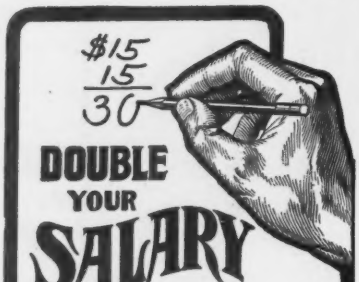

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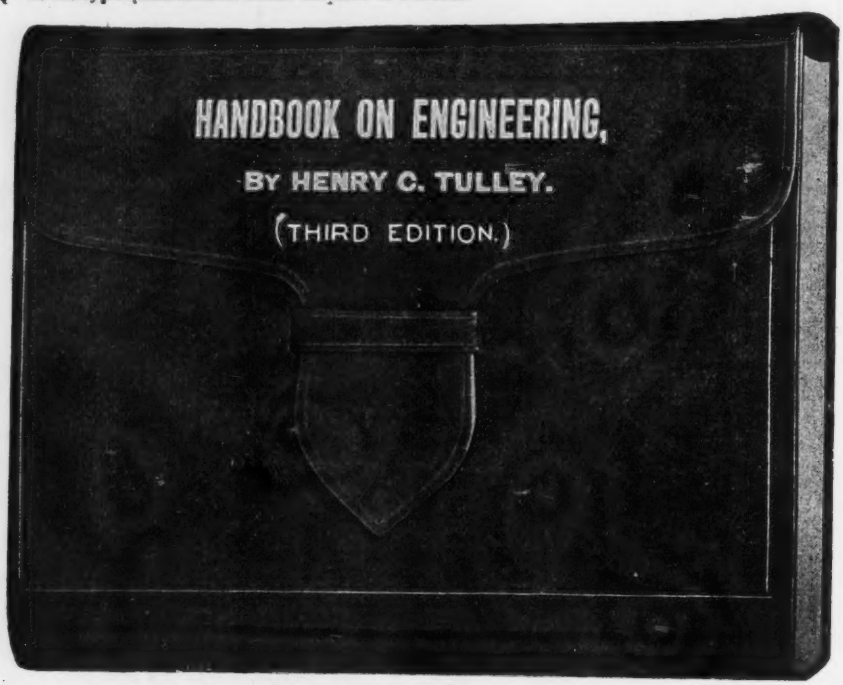

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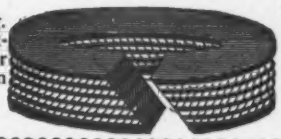

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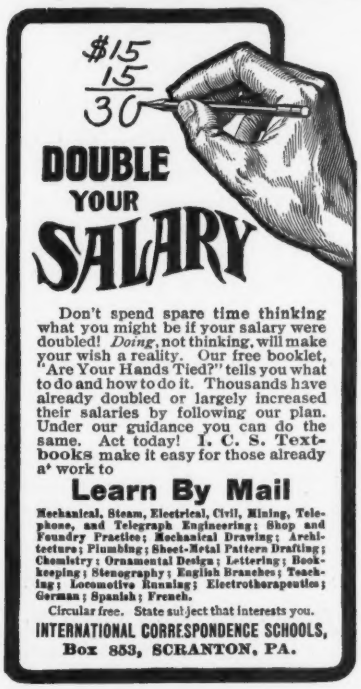

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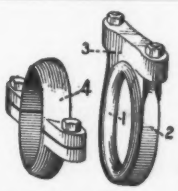

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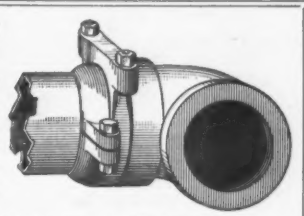

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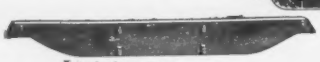

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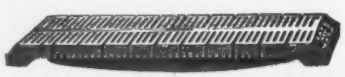

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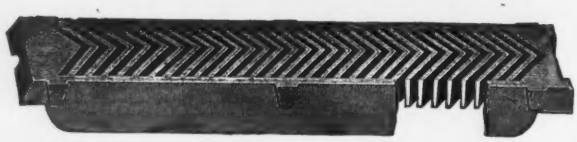
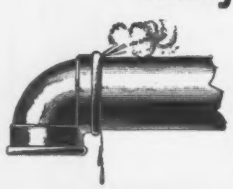
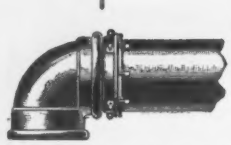


Frick's Pipe Clamps for Stopping Leaky Pipe Joints

PATENTED JUNE 25, 1901





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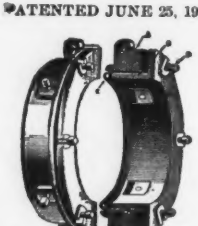

A—Outside or main ring which is bolted around the pipe as close to leaky joint as possible, and secured to pipe by the set screws.
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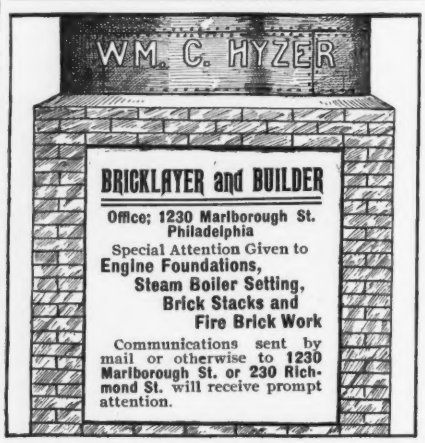
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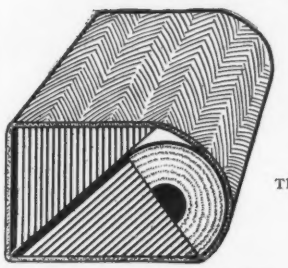

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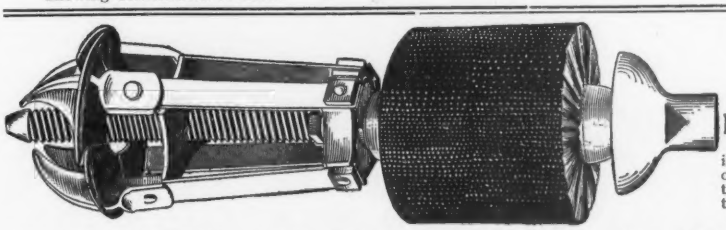

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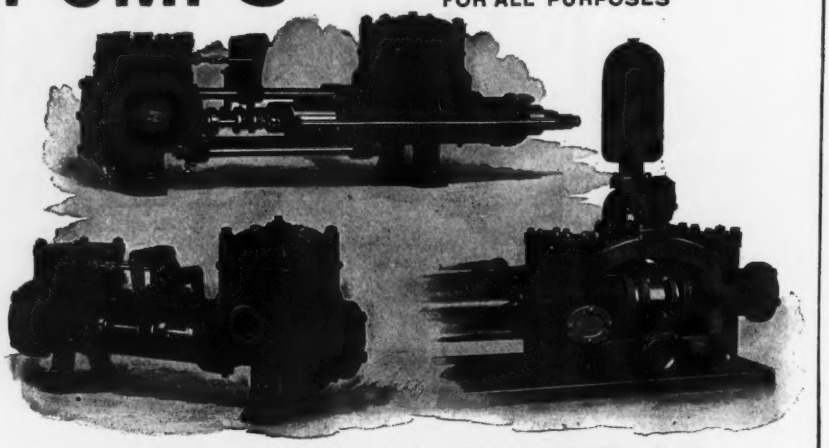

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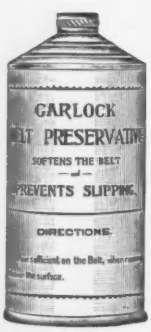

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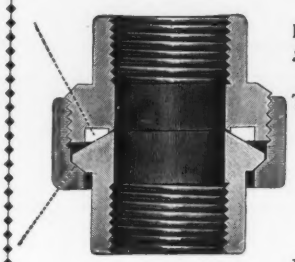

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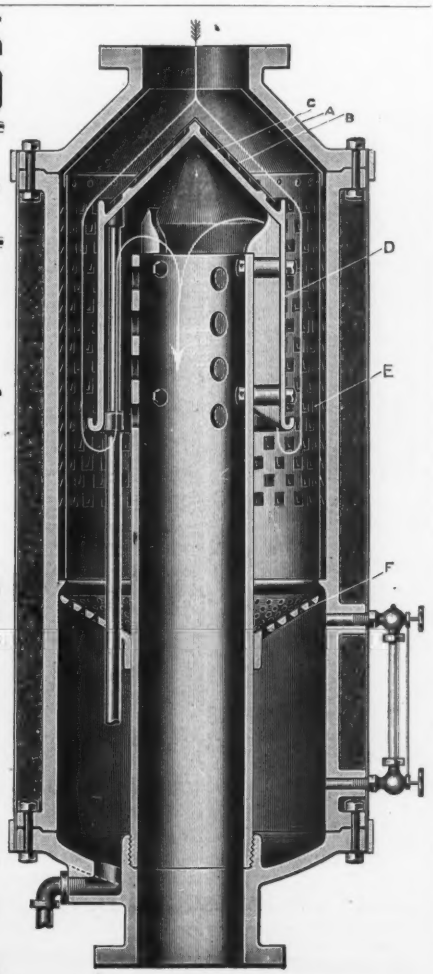

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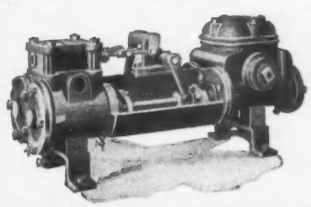

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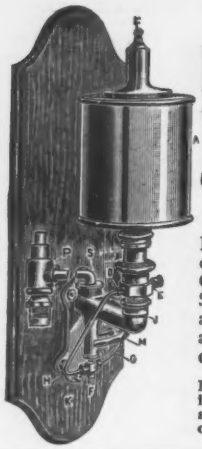

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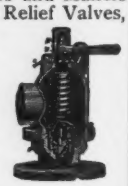

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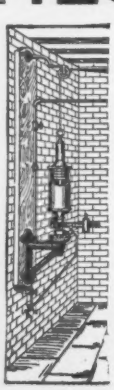

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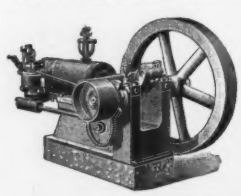

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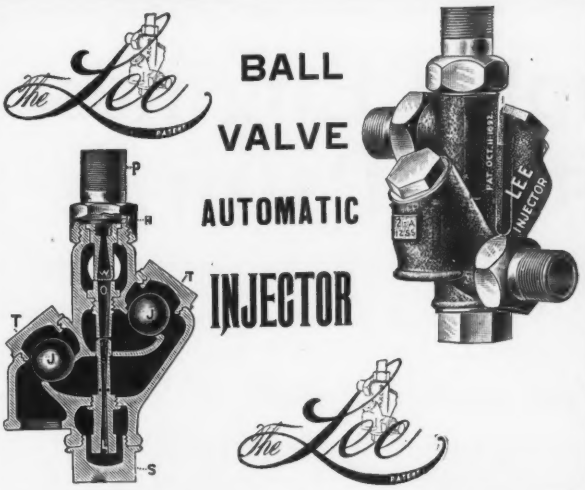

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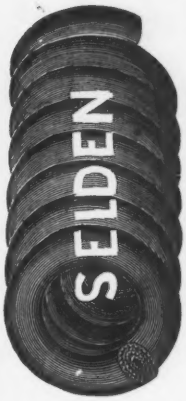

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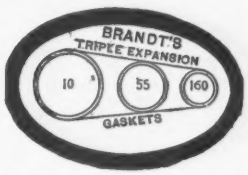

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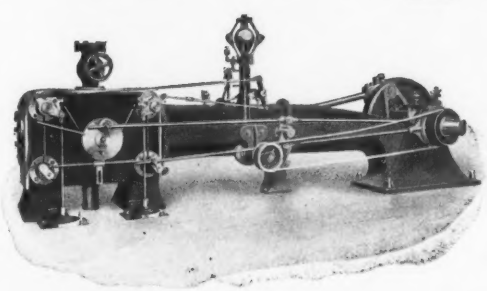

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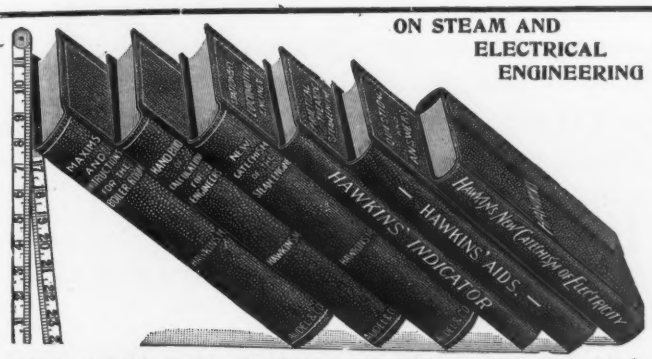

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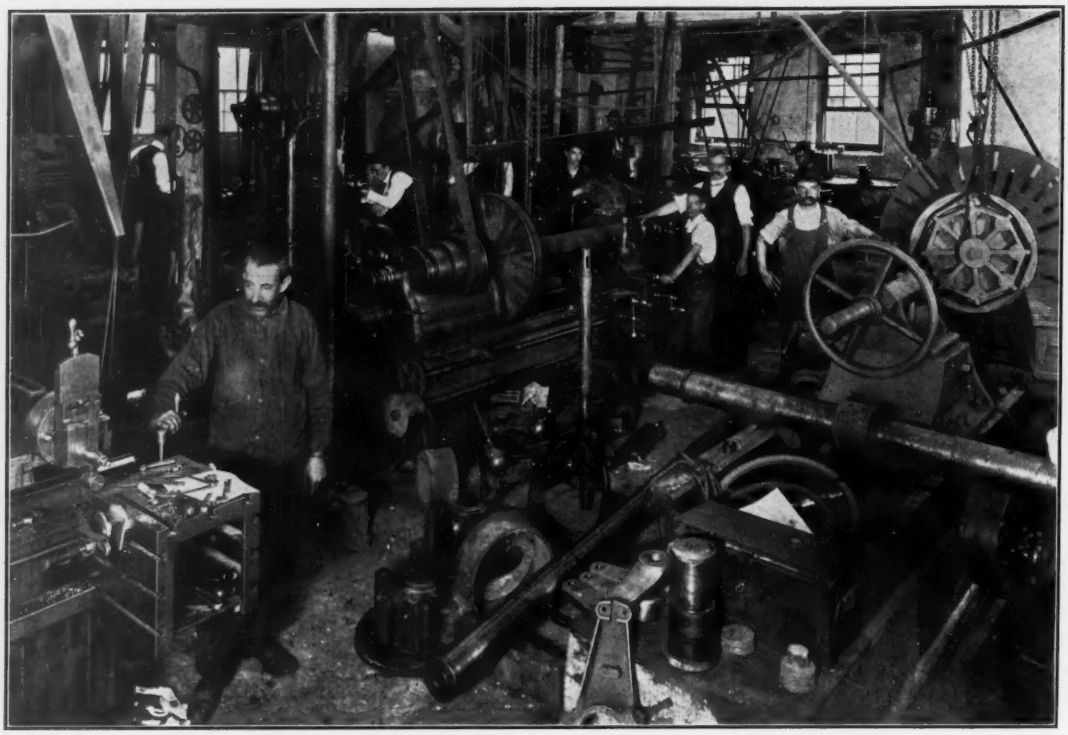

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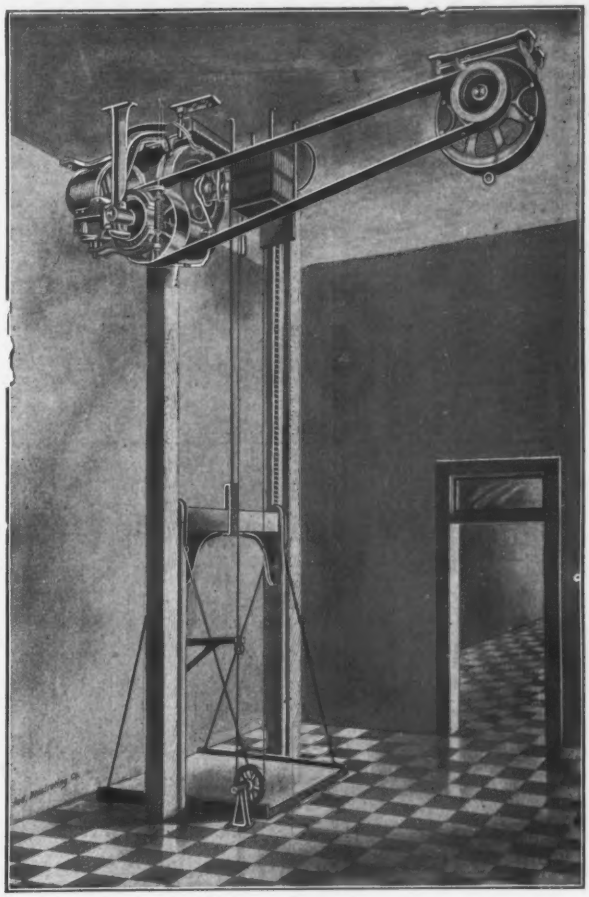

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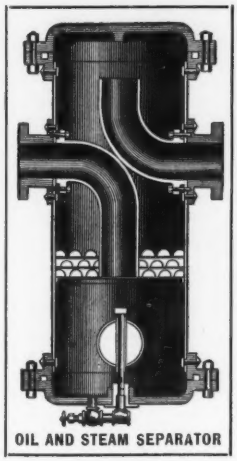

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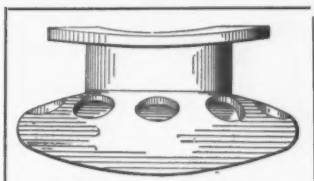
Cylinders Re-bored in their present positions. From 4 inches to 70 inches.

ALL KINDS OF STEAM ENGINE AND STEAM PUMP REPAIRS. GENERAL AND SPECIAL HIGH GRADE MACHINE WORK.

SEND FOR PARTICULARS AND PRICES



FOR INTERIOR OF BOILER

Hoopeston Electric Light & Heating Co.
Hoopeston, Ill., May 12, 1902.
Mr. John T. Lindstrom, Allentown, Pa.
Dear Sir—We have two of your Separators on our two 60" boilers, and find that they are very much improved by them; they were formally very wet, steaming, and gave us considerable trouble with water in our engines. This trouble has entirely disappeared since we put in your Separator. Very truly yours,
Hoopeston Electric Light & Heating Co.
C. J. WAKEMAN, President.

John T. Lindstrom

440 Liberty Street - - - Allentown, Penna.

Rapid Consumption

of fuel and of boilers from scale

Cured by Soft Water

HARD water in boilers makes scale; and scale only one-sixteenth of an inch thick means a consumption of at least ten per cent. more of fuel.

Soft water is the cure for boilers suffering from scale. Using "compounds" and "compositions" is like feeding a consumptive on quack medicines instead of giving him pure food and fresh air.

The BRUUN-LOWENER WATER SOFTENER feeds boilers with water that will not form scale. It saves coal, saves the cost of removing scale, saves damage to the boiler, saves repairs, and saves accidents.

The work is done before the water enters the boiler.

The apparatus is absolutely automatic.

It is absolutely regular.

It is absolutely certain.

ALTHOUGH THE WORK OF THE **BRUUN-LOWENER SOFTENER** IS MORE UNIFORM THAN THAT OF ANY OTHER APPARATUS, YET ITS COST IS MUCH LESS THAN THAT OF ANY OTHER SOFTENER ON THE MARKET.

BRUUN-LOWENER PATENT A W S C.

OUR QUESTION TO YOU

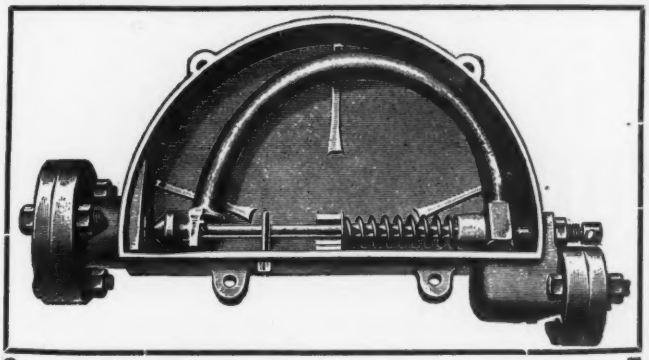
Do you care enough about the saving in cost of fuel, boilers, cleaning, repairs, and accidents, to write and find out what the **BRUUN-LOWENER SYSTEM** has done for others, and what it can do for you?

OUR PROPOSITION TO YOU

After we analyze the water to be treated (an ordinary analysis will not do) we will install a Water Softening Plant on a liberal trial, which we guarantee to do all that we claim for it. If our Softener does not come up to the guarantee we will remove it at our expense.

American Water Softener Company

HARRISON BUILDING, PHILADELPHIA



Who is Hurt?

WE don't mind imitations of the **HEINTZ** trap. We are not the ones hurt by them. We simply accept the compliment—and wait.

It's easy to make a trap that looks just like the **HEINTZ.** Many have tried it—and their traps are gone and forgotten. Other imitations are made under various names, being sold now to people who don't know that the essential secret of Heintz efficiency is in the sensitive compound that actuates the spring.

When the buyers have found them out, and spent good money to replace them with **HEINTZ** Traps, no doubt there will be a fresh crop of imitations.

And who will be hurt?

The HEINTZ Steam Trap is made in nine sizes; capacity 1 to 240 gallons a minute. Guaranteed for one year.

WILLIAM S. HAINES CO.

136 SOUTH FOURTH STREET

PHILADELPHIA

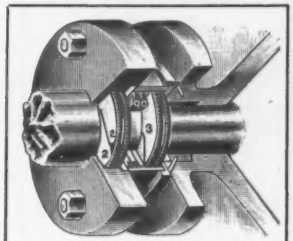
EF

The

France Metallic Piston and Valve Rod Packings

FRANCE'S SPLIT CASE
An Absolute Steam Stopper

Adapted for all kinds and conditions of service



FRANCE'S SOLID CASE APPLIED
Outside Type

ADVANTAGES

No more packing bills
No more re-packing
No more waste of power
No friction

Yes. It is made on scientific principles
It lessens the work of the engineer
It naturally saves fuel
It is sold on its merits

Our guarantee, "Satisfaction or no Pay"

Send for Catalogue

A. W. FRANCE, Tacony, Philadelphia, Pa.

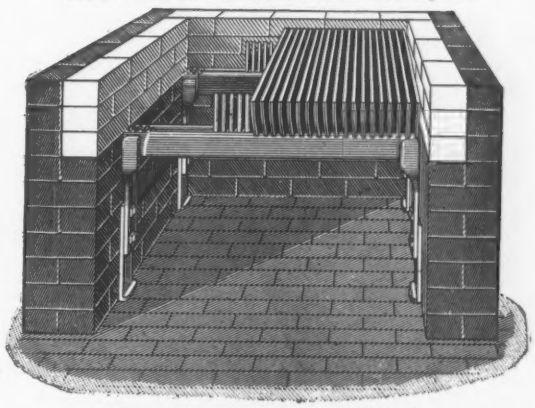
Representatives

T. M. Remington, 237 Sacken St., Brooklyn, N.Y.
A. W. France, Schmidt Bldg., Pittsburgh
Strong, Carlisle & Hammond, Cleveland, O.
Warner & Levy, 816 Fullerton Bldg., St. Louis
Philip Scanlon, Newark, N. J.
Pratt & Center, 123 California St., San Francisco
J. E. Kennedy, P. O. Box 498, Denver, Col.
F. G. Street, Northern Office Bldg., Chicago

WE MAKE ALL TYPES OF

GRATE BARS

But This is the Best and Cheapest



The Longest-lived Grate Bar That Ever Lived.

IMPROVED AMERICAN GRATE BARS

PATENTED.

THE ONLY GRATE WITH ADJUSTABLE FRAME.

THE ONLY GRATE WITH LOOSE TEETH BETWEEN THE BARS.

We wish to call your attention to a few important points in our new Furnace Grates.

The adjustable supporting frame, not coming in contact with the brick-work, saves the walls from getting loose, and can be adjusted to any height desired. The perforated supporting cross bar has less obstruction to a free circulation of air than any other Cross Bar made. The movable teeth between the Grate bars can easily be changed at any time, so as to give an air space between the bars that is desired to accommodate any size of fuel; the Movable Teeth also give the bars more freedom to expand and contract, thereby the bars are less liable to warp.

The American Grate Bars have given satisfaction where others have failed. Are made and for sale only by us; other parties have no right to make or sell them. **Send for circular and references.**

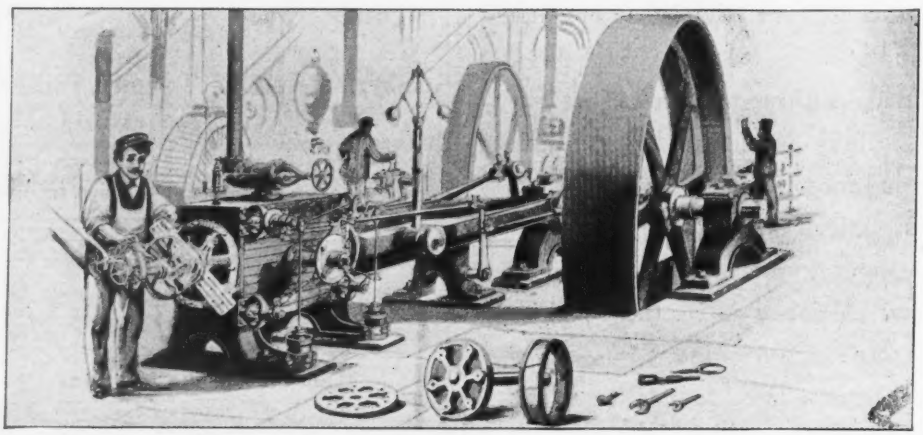
E. J. MOORE MACHINE and FOUNDRY CO.,
SOLE MANUFACTURERS,
2227-2285 WOOD STREET PHILADELPHIA, U. S. A.

Engine and Pump Repairs

HAVE BEEN OUR SPECIALTY FOR THE PAST

THIRTY-TWO YEARS

We overhaul, rebuild and repair more Steam Engines and other Machinery used in connection with Steam Plants than any other shop in this country.



Our Shops are the largest and best equipped for this class of work to be found anywhere. We are prepared, at a moment's notice, to send expert mechanics with special portable tools to any part of the United States.

We Rebore Cylinders and Valve Seats without moving them from their present positions. We also turn off all sizes of Crank-Shaft journal without removal.

WE MAKE OLD ENGINES WORK LIKE NEW

Another Specialty of ours is Turning off Dynamo Commutators in position.
We guarantee every job that we do and every engineer knows that our guarantee is good.
Send for us when you are in trouble, or better still, before you get into trouble.

H. B. UNDERWOOD & CO.

1025 Hamilton St. Philadelphia

See Our Advertisement on inside front cover of this Journal every issue.

PRACTICAL COURSES FOR PRACTICAL MEN

Technical Education by Mail

Correspondence courses offered by **American School, at Armour Institute of Technology:**

Mechanical	Electrical	Stationary	Marine	Locomotive
Navigation	Hydraulics	Surveying	Sanitary	Mechanical Drawing
Perspective Drawing	Textile Work	Telegraphy	Architecture	Sheet Metal Work

Also forty short Special Engineering Courses at low tuition and easy terms.

The School is Open to all who can Read and Write, and are Ambitious to Learn

Lessons are especially prepared for home study by the foremost authorities, and are practical and easy.
Students desiring to attend the excellent night school of the Armour Institute are helped to positions in Chicago.
The School has a wide influence, and can secure for its students and graduates the best positions in the country.
Students are taught by the Faculty of the Armour Institute of Technology.
Tuition within the reach of all, and may be paid in small monthly payments.
All work counts toward a degree of B. S. at the Armour Institute of Technology.
Free use of Employment, Special Inquiry, Patent and Consulting Departments.

OUR SPECIAL EXTENSION OFFER

For the purpose of bringing the benefits of our instruction widely before the public, we wish to enroll in each section of the country a few representative students who will become living evidences of the great benefit of our teaching. For this purpose, we make the following liberal offer: For a short time, each applicant for a Scholarship whose references are satisfactory will be furnished without extra expense through our Library Department, with a splendid $40.00 Technical Reference Library in ten volumes bearing on the subjects included in his course. Successful applicants will be expected to co-operate with us in interesting others in their locality.
Full particulars and catalogue of courses and prospectus of Library sent on request. State course of study interested in, and present occupation.

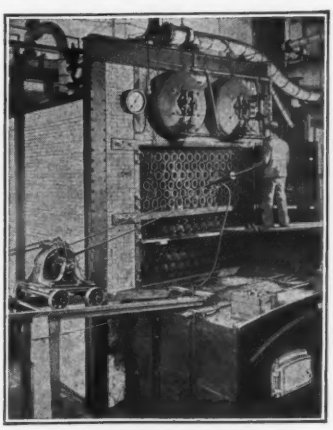
AMERICAN SCHOOL, at Armour Institute of Technology,
308 Armour Avenue, CHICAGO, ILL.

Mention Practical Engineer

Every Engineer and Steam User

...WILL BE INTERESTED IN THIS LETTER ABOUT...

Weinland Tube Cleaners



From a PRACTICAL SUPERINTENDENT of a

MODERN UP-TO-DATE PLANT

OFFICE OF
SYRACUSE RAPID TRANSIT CO.
SYRACUSE, N. Y.

Syracuse, N. Y.,
June 6, 1902.

The Lagonda Mfg. Co.
Gentlemen:

I believe the Mechanical Tube Cleaner purchased from you the best Cleaner on the market. Our Machine will clean a 4 inch by 20 feet Tube that is filled nearly full of hard scale in seven minutes, and the Machine cleaned 528 four-inch Tubes, from 18 to 20 feet long, WITHOUT ONE CENT FOR REPAIRS.

Yours, etc.,
CHAS. F. STEIRLY, Secy.

NOTE! **CONDITION OF SCALE**—Most Cleaners QUIT in HARD SCALE.
TIME OF CLEANING } These are vital points in which THE WEINLAND EXCELS ALL OTHERS
COST FOR REPAIRS }

We make ALL KINDS OF CLEANERS, including OUR IMPROVED TURBINE with special coupling; also Hand Cleaners.
☞ Write us about Boiler Cleaning. We are Experts in that line. Had Twenty Years' Experience—"KNOW HOW." ☜

SHADE & MARSHALL, Agts.,
HARRISON BUILDING, Philadelphia.

THE LAGONDA MFG. CO.,
SPRINGFIELD, OHIO.

HOUGHTON'S MONTHLY LETTER TO ENGINEERS

DEAR MR. ENGINEER:

Our letters in the past have been showing you the way to increase your pay, which was to make more money for your employer.

There is another important thing that you should appreciate.

You should remember that just as you expect profit for your efforts in behalf of your employer, just as your employer expects profits for his increased pay, so do we expect profits for our efforts to please the engineer and work in co-operation with him.

We have heard several competitors criticise these monthly letters and our general policy of working along with the engineer in order that our products might be appreciated.

One of our most formidable competitors said to us: "I would not give a continental for the engineer's influence or good will. I go for the proprietor every time."

Now just so long as the suggestions, original ideas and money saving methods work into the engine room, instead of out of it, the engineer cannot expect to have the boss pay him for what he does not do.

It is important, therefore, that the engineer should encourage not only ourselves, but all others who work along in co-operation with him, who go to the expense of calling his attention to their products.

To take a page like this every month costs money.

We must get our money, thus spent, back.

That would encourage us to continue or to increase.

The engineer is the only man under the sun who can give us that encouragement.

Our success along these lines means that competitors must follow us.

Encouragement to us, therefore, will practically force others to come to the engineer.

Now we have a lot of things you can encourage us by investigating; for, mind you, we ask no orders and no money till our goods have proven their worth. No engineer ever got a "hauling over the coals" for ordering inferior goods from us.

We have the MARCK STEAM TRAP, the greatest fuel economizer known.

VIM Cylinder Oil, the best that ever entered a cylinder.

VICI Hydraulic Cups and Packings that surpass all other leather packings in wear over 100 per cent.

HOUGHTON'S ADHESIVE BELT DRESSING, which has won its place on the market by over a quarter of a century of successful use.

COSMOLUBRIC ENGINE & MACHINERY OILS, popular with engineer and proprietor alike, since 1870.

And almost everything you could think of in the line of engineer's supplies.

Last but not least, we make the most and the best LUBRICATING GREASES. And these greases will not cost you as much as the muck advertised makes, though better in quality.

Send us your inquiries.

Wake up!

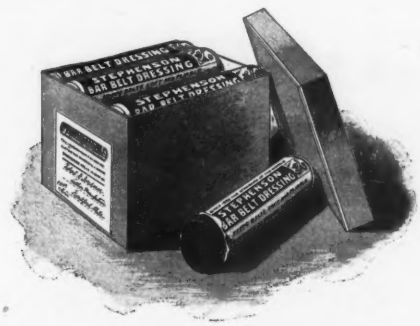
For your sake, for the employer's sake and for our sake.

Yours respectfully,

E. F. Houghton & Company

254 West Somerset Street
PHILADELPHIA

184 Lake Street
CHICAGO



IF YOU ARE AN ENGINEER

Superintendent, Foreman, or have anything whatever to do with the operation or care of belting, let us say to you in all sincerity that it is of just as much advantage, satisfaction and comfort to you to adopt and forever after use **Stephenson Dressing** as it is to us.

Our success in the sale of **Stephenson Dressing** is founded on, and fostered by the intelligence of those who once test it.

We could not continue in business a month were it not for the hundreds of letters we get reading like this:

"Please duplicate our last order for **Stephenson Dressing.** Our men like it, and we find that it lasts a long time."

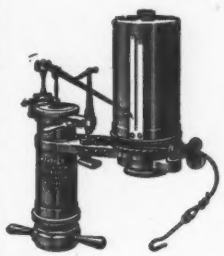
We carry a stock in most of the large cities, and your trial order for one dozen one pound sticks will be promptly shipped you, or we will send a small sample by mail, postpaid.

Let us know your wishes.

STEPHENSON MFG. COMPANY
ALBANY NEW YORK

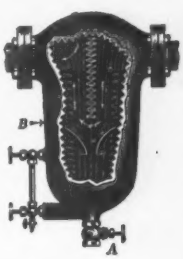
Touch up your local dealer on **Stephenson Dressing.** He ought to get in line—if he's awake .·. .·.

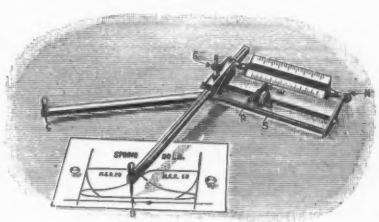
WE could not pack any more packing goodness into our EUREKA PACKING no matter what we charged for it. The price pays for the best packing made.



THE engineer who wants to get on should get on to the fact that an improved ROBERTSON-THOMPSON INDICATOR Indicates the progressive engineer.

THE HINE ELIMINATOR for separating water from live steam and oil from exhaust is the best—not only our best, but the world's best.





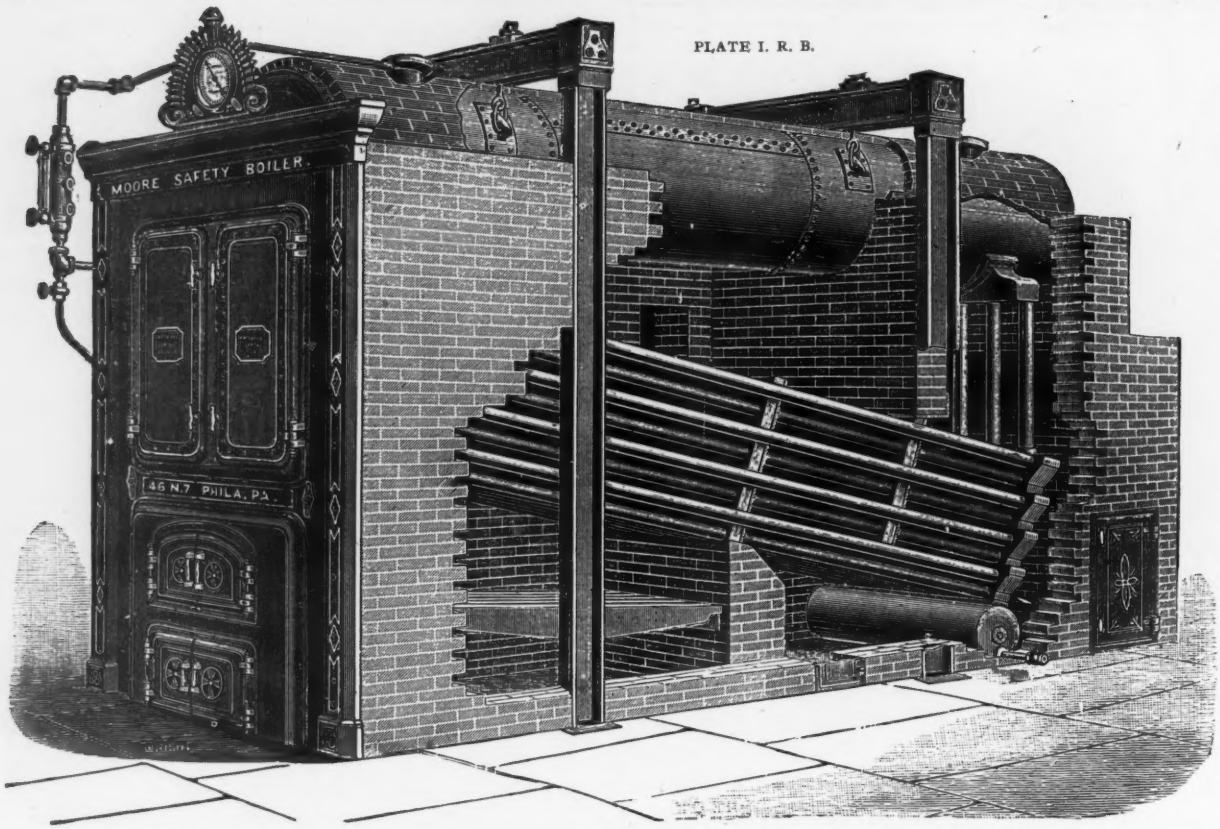
THE engineer with a PLANIMETER is a good deal nearer advancement than the engineer without. The WILLIS PLANIMETER should be the one.

ALWAYS ready for any speed up to 500 revolutions, and stroke to five feet, and it takes less than five minutes to connect.

IMPROVED VICTOR REDUCING WHEELS made to fit any indicator.

Our catalog will interest you. It describes Damper Regulators, Feed Water Heaters, Steam Flue Cleaners, etc., and is yours for the asking.

Jas. L. Robertson & Sons. 205 Fulton Street, New York.
Boston Philadelphia St. Louis



MOORE'S HIGH PRESSURE SAFETY STEAM BOILERS, 800,000 H. P. in use, both in Europe and America

Repairs of Water Tubes. Boilers of all types a specialty. We have special tools for this purpose.
We keep constantly on hand ready for shipment 1000 horse-power. There can be no delay. **Send for Catalogue.**

ESTABLISHED 1864 PHONE

E. J. Moore Machine & Foundry Co.

MACHINISTS, FOUNDERS & PATTERN MAKERS

Gray-White, Semi-Steel Aluminum Alloy Castings. Mills and Pulverizers for Minerals, Cereals, &c. Stamping and Embossing Presses, Roller Mills.

2227-2235 WOOD STREET **Philadelphia, Pa., U. S. A.**

RICHARD H. REILLY JAMES J. FEARON RICHARD H. REILLY, Jr.

EAGLE IRON WORKS

TELEPHONE ESTABLISHED 1851

REILLY & FEARON

OFFICE SUCCESSORS TO HOFF & FONTAINE WORKS

1160-1162 North Third Street MANUFACTURERS OF 1152-1164 North Third Street

PHILADELPHIA PHILADELPHIA

ENGINES, BOILERS, STACKS AND TANKS

General Machinists and Iron Founders

Complete Power Plants
Steam Fitting
Goodwin Cut-off Governors
Engines Indicated

Conveying Machinery
Blacksmithing
Wrought Iron Work
Special Machinery

Millwrighting
Mill Supplies
Pulleys
Shafting

Clyinders bored in position
General Repairs to
Ice Machinery
Engines, Boilers, Pumps, etc.

The Busiest Shops in Philadelphia

PHILADELPHIA BRANCH

I. B. Williams & Sons,

722 ARCH STREET

Manufacturers of

OAK TANNED LEATHER BELTING,

RAW HIDE AND TANNED LACE LEATHER,

ROUND BELTING,

MILL AND AGRICULTURAL STRAPPING.

SOLE AGENTS FOR

OHIO VALLEY PULLEY WORKS,
MAYSVILLE, KY.

Limestone Wood Split Pulleys,
All Sizes
From 4 to 48 inches
In Stock.

PITTSBURG WHITE METAL CO.,
160 LE ROY ST., N. Y.

Best Engine Bearing Metal,
Roller Mill Babbitt,
Genuine Purpose Babbitt,
The Best No. 4 Babbitt Made.

NEW JERSEY CAR SPRING & RUBBER CO.,
JERSEY CITY, N. J.

Mechanical Rubber Goods,
Packing,
Fire Hose.

WALTER L. FLOWER CO.,
ST. LOUIS, MO.

Acme Oil Filter,
The Only Perfect Oil Filter
On the Market.

VALLEY IRON WORKS,

WILLIAMSPORT, PA.

The most improved and modern Ring Oiling and Adjustable Hangers and Pillow Blocks.

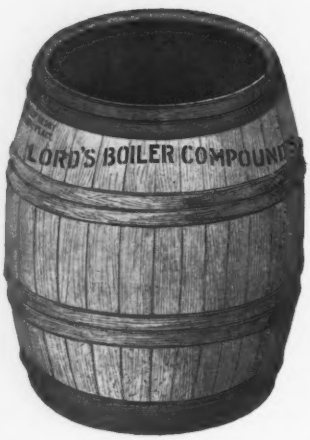
Estimates furnished on complete Power Transmission Plants.

A full line of Mine, Mill and Railroad Supplies of every known variety.
New Goods, New Methods, Prompt Attention, Quick Deliveries
and Lowest Prices.

Bell Telephone 6-84.

LORD'S COMP

Have been in constant and successful use for forty years, and are recognized as THE WORLD'S STANDARD.



More of Lord's Compounds are sold annually, both in America and Europe, than of all other preparations.

WHY

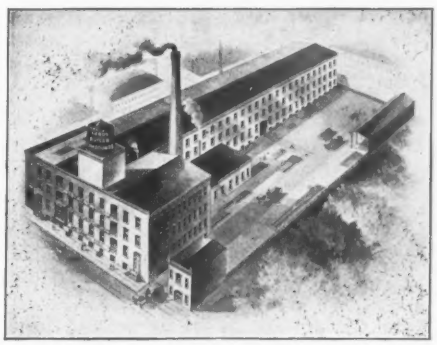
Because they do better work

They will save money *for every operator of a steam boiler by keeping the boilers always clean and free from scale, thus enabling you to generate steam with* **much less coal.**

The demand for our Compounds has increased so rapidly that we are now building a large addition to our plant. The new building is in course of erection at 2241-45 Delhi Street, in the rear of our Main Works.

BOILER OUNDS

They are prepared specially for each feed water, and every shipment is guaranteed to give perfect results.



Our labratories for analyzing feed waters and boiler scale are equipped with every modern appliance and are in charge of the best water chemists in the world.

Send us a sample *of your feed water or a piece of scale and we will analyze it for you free of charge.*

We are now making special compounds for Schuylkill and Delaware River waters which are giving perfect satisfaction in every case. If you are not using them, you should place a trial order at once.

Don't fail to send sample of scale for free analysis.

GEO. W. LORD

2238-2250 NORTH NINTH STREET PHILADELPHIA

The Keystone Chemical Mfg. Co.
Camden, N. J.

TRADE MARK REGISTERED

Gentlemen:

We sent you an order a day or two ago for another barrel of Keystone Tri-Sodium Phosphate.

We have for several years used it in our boilers here, about 350 horse power, and have found it uniformly satisfactory. The water we have is quite hard containing quite an amount of Carbonate of Lime, Magnesia and Salt.

By using Keystone Tri-Sodium Phosphate we do not have to shut down to clean boilers every twenty days as formerly and THERE IS A VERY NOTICEABLE AND APPRECIABLE DECREASE IN OUR FUEL BILL. It does what you claimed for it in our case. We do not undertake to run without it.

Yours truly,

W. E. Worth

KEYSTONE
TRI-SODIUM PHOSPHATE

Has succeeded where all boiler compounds have failed in the bad water districts throughout the country, but like all good things it is being imitated, therefore

REMEMBER THE TRADE MARK

TRADE MARK

NONE OTHER GENUINE

REGISTERED

Send a Sample of Your Feed Water

—

Analysis Free

KEYSTONE CHEMICAL MANUFAC

Gulf Red Cedar Company
Greenville, Ala.

Greenville, Ala., 8-6-02.

Keystone Chemical Mfg. Co.
Camden, N. J.

Gentlemen:

We have your favor of the 4th inst. Your prices on your Keystone Tri-Sodium Phosphate are all O. K. We also wish to say you may use our letter as a testimonial, as the market is so full of frauds in the way of boiler compounds, that when we get hold of a good boiler compound, we feel like letting our friends know it.

Yours very truly,
GULF RED CEDAR CO.

Manager

TRADE MARK REGISTERED

TRADE MARK REGISTERED

KEYSTONE
TRI-SODIUM PHOSPHATE

Unlike other Boiler Compounds, does not pass off with the steam. Purifies the worst Feed Water so thoroughly at a minimum cost that it leaves no excuse for installing an expensive water softening plant.

NONE GENUINE

WITHOUT THIS TRADE MARK TRADE MARK REGISTERED

Send for our Booklet "WORTH KNOWING" Free to Engineers

TURING COMPANY, CAMDEN, N. J.

EVER TRY

KEYSTONE

Grease For Lubricating Machinery?

CHAS. A. HOPPER

ALMOST EVERY PHILADELPHIA ENGINEER WILL RECOGNIZE IN THE CUT THE FACE OF MR. CHAS A. HOPPER, PHILADELPHIA REPRESENTATIVE OF THE KEYSTONE LUBRICATING CO. HE SCORES A BIG HIT AS A GENIAL, JOVIAL, GOOD COMPANION, ONE OF THE SORT THAT'S ALL RIGHT. THE KIND OF A FELLOW WE ALL LIKE. INCIDENTALLY HIS WORD IS AS GOOD AS THE GREASE WITH WHICH HE IS IDENTIFIED

BETTER TRY KEYSTONE

GREASE

BEATS OIL

MUCH CLEANER
LASTS LONGER
COSTS LESS
MAKES FRICTION LOAD LIGHTER

WE want you to give KEYSTONE GREASE a trial. Drop us a postal and we will send you a large can for testing and a Keystone Grease Cup FREE. Express paid.

KEYSTONE LUBRICATING CO.

20th St. & Allegheny Ave., Philadelphia

RED SEAL BOILER COMPOUND

MANUFACTURED BY

THE CHERRY CHEMICAL COMPANY

Office: 1215 Filbert Street, Room No. 810, PHILADELPHIA, PA., U. S. A.

CONTAINS NO ACIDS
PURIFIES THE WATER
PROLONGS THE LIFE OF THE BOILER
SAVES FUEL, TIME AND LABOR
DOES NOT INJURE OR CORRODE THE IRON
PREPARES THE WATER TO MAKE PURE STEAM
ITS ACTION ON OLD SCALE IS GRADUAL AND CERTAIN
PREVENTS GROOVING, PITTING AND WASTING OF IRON

OUR COMPOUND IS MANUFACTURED STRICTLY ACCORDING TO ANALYSIS

WHEN WRITING, SEND US A SAMPLE OF YOUR SCALE

RED SEAL
BOILER COMPOUND
FOR THE REMOVAL AND PREVENTION OF SCALE, GREASE AND DIRT IN STEAM BOILERS WITHOUT INJURY TO THE IRON
MANUFACTURED BY THE
CHERRY CHEMICAL CO.
MAIN OFFICE
1215 FILBERT ST.
PHILA., PA.

Trade Mark Registered

OUR SYSTEM OF REMOVING BOILER SCALE IS A SUCCESS. TRY IT

TESTIMONIALS OF MERIT FROM ALL PARTS OF THE COUNTRY

☞ RED SEAL BOILER COMPOUND is entirely free from acids, vegetable extracts, oils, volatile constituents or anything that would contaminate the steam and give it odor, flavor or color. In its action it does not vaporize or pass off with the steam. It can be used with perfect safety by Breweries, Dye Houses, Hotels, Refineries, Laundries, Ice Plants and many other establishments too numerous to mention, where pure live steam is required.

The Compound is in powder form, dissolves easily in warm water, and, as a liquid, can be supplied to the boiler through the pump or injector, or in any other convenient way.

All we ask is a trial of RED SEAL BOILER COMPOUND, and we will convince the most skeptical that it is a superior article to many of the so-called boiler compounds on the market.

DIRECTIONS FOR USE CHEERFULLY FURNISHED ON APPLICATION

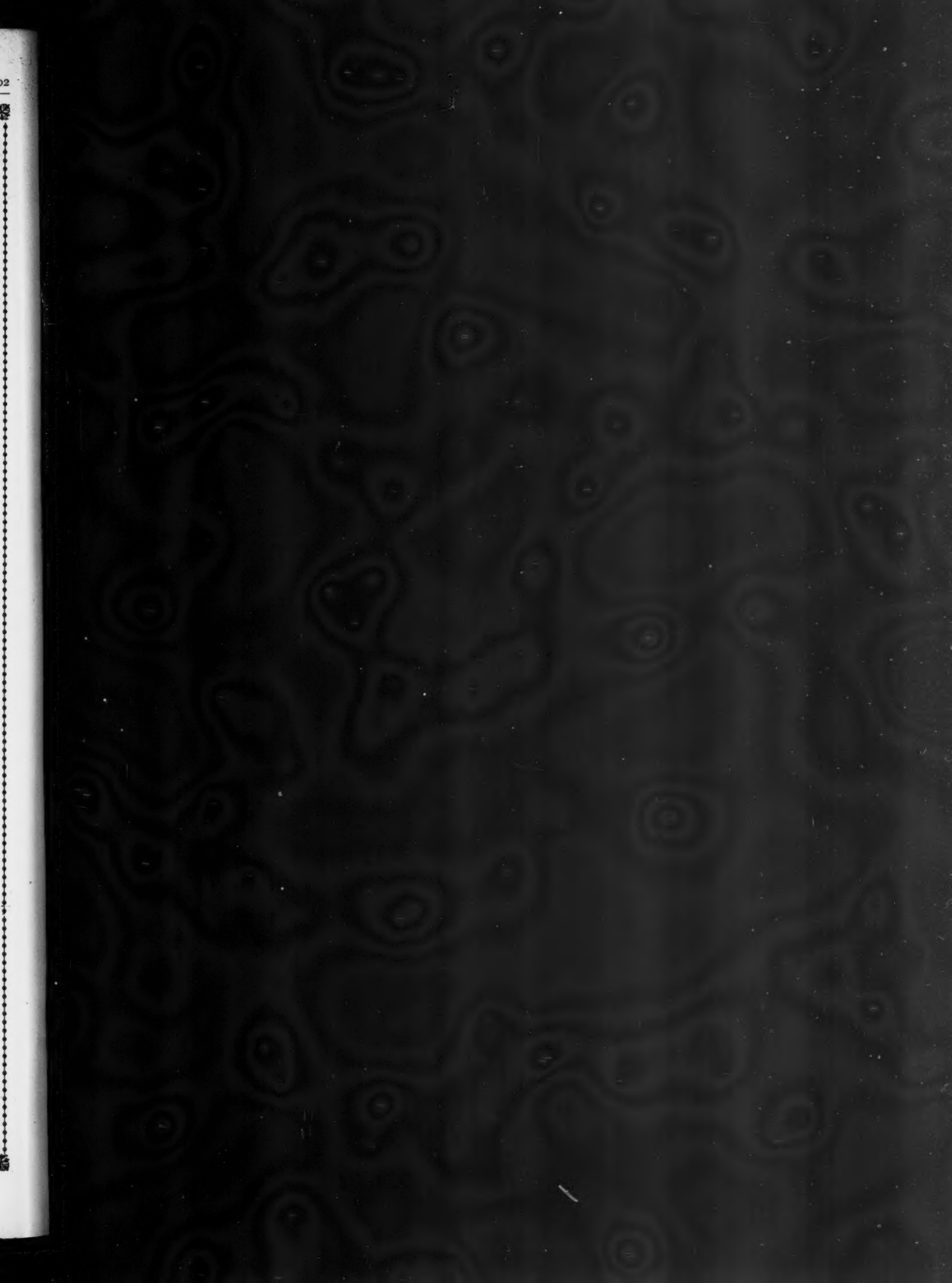
RED SEAL BOILER COMPOUND

IS SOLD IN THE FOLLOWING SIZE PACKAGES:

HALF BARRELS, 100 to 200 LBS. . . . . } PRICES FURNISHED ON APPLICATION
BARRELS, 250, 300 and 400 LBS. . . . . }
CASKS, 500 to 600, 800 and 1000 LBS. . . . . }

WE HAVE SUPPLIED HUNDREDS OF STEAM USERS FOR YEARS

Good Agents Wanted — Liberal Commission Paid — Write for Terms



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The Lunkenheimer Steam Whistles are warranted to blow and satisfy the most exacting. All goods tested and warranted first-class. Specify *Lunkenheimer* make and order from your dealer. Write for catalog of superior Brass and Iron Engineering Appliances.

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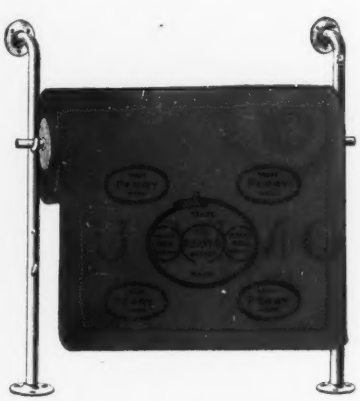
Are INDEPENDENT of any Trust or Combination, and the general verdict is that

Perry's Red and Brown Sheet Packings



are the only old and original goods now offered to the trade, and that PERRY'S SPECIALTIES in Steam Packings, for all purposes, are made upon honor, have no superiors, and are guaranteed in every respect.

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Manufactured by the

La Favorite Rubber Mfg. Co.

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'96 Jenkins Standard '96 Packing '96

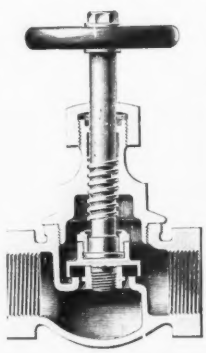
The Perfection of Joint Packing. Do not accept unless it bears our Trade-Mark as shown in the cut.

Use Jenkins '96 Sheet Packing on th worst joint you hav , and if it is not what we claim we will refund th money.

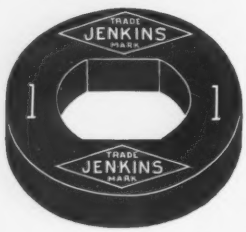
JENKINS '96 PACKING has stood the most crucial tests under all conditions of service with steam, oils, acids, ammonia and the like, and in no case has it failed to make a perfect joint when properly applied. Can be placed in a joint either hot or cold, and will make joint instantly. Full steam pressure can be turned on at once when joint is made, it does not require to be followed up and will not blow out. It vulcanizes in place and forms a compound that will not rot or burn out, but will last as long as the metals which hold it. It joins with rough surfaces equally as well as when they are faced. **Jenkins Standard '96 Packing** weighs less than most joint packings. When compared with equal sizes of other packings sold at a lower price per pound, it will be found to cost less per square yard.

Jenkins Brothers' Valves

Design, workmanship and materials of the highest standard throughout. Every valve inspected and tested before leaving the factory. Made in all styles and sizes, both brass and iron.



Jenkins Discs



Do not be deceived when you are offered discs "just as good" or better than the Jenkins, as many worthless imitations of our discs are on the market. We are the original manufacturers of this class of goods, and we have tried to maintain the high standard in which they are held by steam users throughout the world. Copper, lead, Babbitt and all kinds of metal discs have been experimented with for the past twenty years, and in almost every instance, when under the action of steam, they become oxidized and hard, so that chip or scale getting between the disc and seat causes a leak, which necessitates regrinding. Insist on having the genuine Jenkins Discs; the difference in cost will not pay you to experiment. If you wish discs for any particular purpose, write to us; we can experiment cheaper for you than you can for yourselves. **Jenkins Discs will stand steam, oils or acids. We have special soft discs for cold water**

Jenkins Brothers' Pump Valves

Adapted to every pumping requirement, these valves are especially suited for pumping hot water, syrups, beer and other destructive fluids; also muddy and gritty water. When rubber valves have been found useless, these valves have given entire satisfaction.

For mining and high-pressure service, also for elevator pumps, Jenkins Brothers' No. 88 Pump Valves are in use under 450 pounds pressure, and are proving themselves equal to every requirement.

We also manufacture a fine grade of Soft Rubber Valves for cold water and air service.

When ordering valves, please state for what purpose you desire to use them.

Jenkins Brothers' Valves, Jenkins '96 Packing and Rubber Specialties received the Highest Awards at the Pan-American Exposition

All our different specialties are stamped with Trade-Mark

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